

Microsoft®

101 Ideas

For Innovative Teachers



101 ideas for innovative teachers

Commissioned
by
Microsoft Hungary

Edited by:
Ádám Merényi, Vince Szabó, Attila Takács

JEDLIK OKTATÁSI STÚDIÓ
Budapest, 2006



Published by Jedlik Oktatási Stúdió Bt.
H-1212 Budapest, Táncsics M. u. 92.
Internet: <http://www.jos.hu>
E-mail: jos@jos.hu

© Jedlik Oktatási Stúdió Bt. 2006

Acknowledgements:

Authors:

Mónika Burgetti
Erzsébet Csibi
Sándor Demjén
Bálint Farkas
Csaba Farkas
József Holczer
Zsuzsa Horváth
Beáta Jarosievitz
Jedlik Oktatási Stúdió
Ferenc Péter Lakó
András Márton
Csaba Mura-Mészáros
László Obuch
Balázs Pethő
Sulinet Agency
Marcell Szabó
Zsuzsa Szalayné Tahy
Attila Takács
Andrea Telek

The chapter "Effective techniques for the organization of learning" was edited by Gyöngyvér Vitéz.

Proofreaders: Edit Somogyi (content), Zsuzsanna Lakner (language)

Cover design by Csaba Sarkadi, 2005

Text capture and processing by Antal Gábor Fodor

While every effort has been made to trace any possible mistakes in the making of this book, if anything has been inadvertently overlooked the publishers welcome your comments and will make the necessary amendments at the first opportunity.

Printed in Hungary

ISBN 963 87000 1 7
JO 9011

Introduction

Dear Educator,

Technology has the potential to remove barriers for students and educators all over the world. Powerful software and the Internet are changing our access to knowledge. Innovative ways to teach and learn are redefining the classroom experience. And there are new expectations for students: beyond basic skills, they need proficiency in collaboration, communication, and information management – all 21st century skills –, and access to the learning tools that put these skills within reach.

The goal of the Partners in Learning program is to empower schools to enhance student learning through teacher development and leadership. Together with our partners, the Education team at Microsoft would like to thank you for your dedication to your students and life-long learning. We hope this book will help you make a difference, and help all students realize their full potential.

Sincerely,

Daniel Maly
Senior Education Program Manager
Microsoft Corporation

Contents

INTRODUCTION	
CONTENTS	
I. EFFECTIVE TECHNIQUES FOR THE ORGANIZATION OF LEARNING	1
Traditional organization of learning	1
<i>Frontal class work</i>	1
<i>Independent work</i>	1
Effective techniques for the organization of learning: Constructive pedagogy	1
<i>Differentiation in class</i>	2
Sources of differences between pupils	2
The basic principles of differentiated organization of learning	2
Different levels of the differentiated organization of learning	2
Basic principles of differentiation	3
<i>Organizational forms in learning</i>	4
Group work	4
Pair works	5
Individual work	6
Differentiated processing of the material with worksheets	6
Preparing tasks to keep pupils busy	6
<i>The phases of constructive education</i>	7
Recommended types of lessons	7
Types of tasks	8
<i>Organization of cooperative learning</i>	8
Problem-based learning	8
Cooperative discussion	9
Drama as a teaching technique	9
Cooperative learning according to Kagan	10
Pedagogical project	13
Comparing traditional pedagogy to constructive pedagogy	14
<i>Personal conditions</i>	14
The teacher's point of view	14
The pupils' point of view	16
The question of testing and evaluation	18
II. TASKS	19
Geography	19
<i>Take photographs of the stellar sky (to demonstrate gyration)</i>	19
<i>Display the shifting of water levels on a river or creek</i>	19
<i>Measure the daily alteration of air-temperature</i>	20
<i>sights you visited during a summer holiday</i>	
<i>Use your own pictures to make a presentation about a country, region or some</i>	20
<i>Make a homepage for a geographical display about the local environment</i>	20
<i>Create a notice-board or display about volcanism</i>	21

<i>Gather information about the most devastating earthquakes in the last few years</i>	21
<i>Show the vertical alteration of air-temperature with the help of calculation and graphical representation</i>	21
<i>Make a calendar using pictures of sights taken on a school-trip</i>	22
<i>Make a map of the surroundings of the school</i>	22
<i>Display rocks using a Webcam and a projector</i>	22
<i>Create maps</i>	22
<i>View from above</i>	23
<i>Virtual tour in a Zoo</i>	23
<i>My Zoo</i>	23
<i>Card</i>	23
<i>Solar Eclipse</i>	23
<i>Where to go on holiday</i>	24
<i>Water-levels</i>	24
<i>Atmosphere</i>	24
<i>Residence</i>	24
<i>Geological Periods</i>	25
<i>Temperature album</i>	25
<i>Sunny Hours</i>	25
<i>A rainy day in...</i>	25
<i>Weather report</i>	26
Biology	27
<i>Use slides to illustrate the stages of germination</i>	27
<i>Present plant species native to your close environment</i>	27
<i>Take your pulse rate after exercising, and make diagrams</i>	27
<i>Record the sound of birds</i>	28
<i>Make diagrams of food chains</i>	28
<i>Write an essay about the life and work of a famous scientist</i>	28
<i>Greenery</i>	29
<i>Make a plant morphology quiz with pictures</i>	29
<i>Update your knowledge concerning human evolution</i>	29
<i>Make a short movie on a biological experiment</i>	30
<i>Design a label for the Biology exercise book</i>	30
<i>The evolutionary development of the plants and animals</i>	30
<i>Smoking kills</i>	30
Literature	31
<i>Compulsory Reading</i>	31
<i>Home essay</i>	31
<i>Literary journey</i>	32
<i>The Uffizi art gallery</i>	32
<i>Comparing the Renaissance and the Baroque view</i>	32
<i>Literary quiz game</i>	33
<i>Artistic presentation</i>	33
<i>The life of a famous poet</i>	33
<i>Motive research</i>	33

<i>Write footnotes to an ancient classic</i>	34
<i>Photo story / Mini film / Blog</i>	34
Language	35
<i>Genres of journalism</i>	35
<i>Daily Paper</i>	35
Mathematics	36
<i>Minesweeper for improving mathematical abilities</i>	36
<i>Graphic solutions of problems in spreadsheets (e.g. oncoming vehicles)</i>	36
<i>“Construction” with a drawing tool</i>	37
<i>Function-transformation with animation</i>	37
<i>Simplifying algebraic equations - Microsoft Equation</i>	37
<i>Studying trigonometric functions on computer</i>	37
<i>Proving Geometrical Propositions in presentation</i>	38
<i>Budget for the school snack bar</i>	38
<i>Using formulas in general (calculating data of right triangles)</i>	39
<i>Probability - Analyzing average, dispersion and distribution using the RAND() formula</i>	39
<i>Analyzing complete induction - comparing recursive and explicit formulas</i>	39
<i>Transforming functions</i>	39
<i>Prime numbers</i>	40
<i>Plotting formulas</i>	40
<i>Installments</i>	40
Physics	41
<i>Presentation of the convex lens</i>	41
<i>Refraction of light on a lens and reflection from a mirror</i>	42
<i>A distance-time problem</i>	42
<i>The evaluation of the results of measurements (e.g. measuring gravitational acceleration with a dropping machine)</i>	42
<i>Demonstrating constant acceleration approximating with constant motion</i>	43
<i>The dynamics of the motion of waves</i>	43
<i>Lissajouse patterns</i>	43
<i>The demonstration of circuit diagrams</i>	44
<i>Analyzing combination circuits</i>	45
<i>Creating the schematic diagram of a real circuit (the strings always take a different path)</i>	46
<i>A drink - The generic solution to an problem in thermodynamics</i>	46
<i>Measuring the temperature of water in different vessels, covered or uncovered, and on different kinds of heaters</i>	46
<i>Learning about radioactivity</i>	46
<i>Teaching radioactive decay series</i>	47
<i>Teaching resonance (forced vibration)</i>	48
<i>Teaching motion with a constant acceleration</i>	48
<i>Teaching the swinging pendulum</i>	48
<i>Teaching Brownian motion</i>	50
<i>Teaching the practical uses of chain reactions</i>	51

<i>Newton's gravitational laws, and planetary motion</i>	51
History	53
<i>Calling cards for great people in history</i>	53
<i>Making a gazette-like historical newspaper</i>	53
Foreign Language	54
<i>Biographies</i>	54
<i>Vocabulaire de la cuisine</i>	54
<i>Les curiosités de Paris</i>	55
<i>Plastic surgery</i>	55
<i>My hypermarket</i>	56
<i>Whose horoscope is it?</i>	56
<i>Holiday time</i>	57
<i>Local festival</i>	58
Chemistry	58
<i>Food additives</i>	58
<i>Molecule Models</i>	58
<i>Game</i>	59
Information Technology	59
<i>Introduction video for Parents' Day</i>	59

I. EFFECTIVE TECHNIQUES FOR THE ORGANIZATION OF LEARNING

Traditional organization of learning

Frontal class work

This is the most frequently used way of teaching in present-day Hungarian education. It is functional, most of all, in disclosing new concepts or presenting new material to pupils. These lessons provide few opportunities to involve the pupils. Furthermore, keeping the attention of the class for 40-45 minutes is also a difficult task for the teacher. The teacher is the source of information and pupils, as receptacles, take in the material. Communication is usually verbal and one-way, aiming to provide (and receive) information. Teaching - learning interactions are very few in numbers.

Independent work

In this case the work can be done independently, in pairs, or in groups. The point is that pupils work independently. Tasks are not tailored to the needs of the individuals, everyone does the same task. Differences in the personalities and abilities of the pupils are not taken into consideration in the choice of tasks.

Effective techniques for organization of learning: Constructive pedagogy

Constructive pedagogy is a generic term. It is not a method but an approach based on the assumption that knowledge is developed (constructed) by the individual by actively participating in the cognitive process. This process of thinking also requires the pupil to cooperate with others. A simplified and structured curriculum cannot provide the pupil with this experience but realistic situations can.

Creating a complex learning environment is essential. The source of information is not books and teachers any more; it is real life. Pupils have a chance to seek solutions to real problems in life-like situations in a variety of ways with different techniques in groups. Constructive pedagogy requires special learning conditions in which pupils are allowed to cooperate with and provide help to each other. They can use a range of tools and information sources to solve their problems and reach their goals.

Several pedagogical methods and learning techniques (like problem focused and project based learning) can be applied in classrooms where PCs are available. Classrooms equipped with PCs are much more suitable for applying state-of-the-art techniques than traditional ones, even if there are not enough computers for every pupil. Under properly organized learning and working conditions one or two PCs are enough to induce a cooperative cognitive process. The typical IT room with its compact space and inflexible arrangement of desks does not facilitate the integration of modern info-communications devices in the process of education.

Differentiation in class

Frontal work does not give the teacher a chance to take into consideration the differences between individual pupils.

Sources of differences between pupils

- Differences in background knowledge - family background (vocabulary, set of values, knowledge)
- Differences in cognitive capacity:
 - Perception (What can be taught to a pupil with any disability, e.g. blindness or impaired hearing)
 - Attention span
 - Memory
 - Thinking and language - 7 types of intelligence
 - Language -verbal
 - Logical- Mathematical
 - Visual
 - Motor/Kinetic
 - Musical
 - Interpersonal
 - Intrapersonal
- Pupils with different characters have a different:
 - Style of learning
 - Motivation
 - Attitude
 - Interests
 - Dominance of the cerebral hemisphere
- Gender
- Ethnic background

The basic principles of differentiated organization of learning

These above mentioned differences make it unavoidable for teachers to adopt a new attitude in methodology and include new methods and techniques in their repertoire.

The most important questions for reflection:

- How could I teach more effectively?
- How could I give help?
- How could I make my pupils' attitude toward school more positive?

Different levels of the differentiated organization of learning

Forming groups according to pupils' interest

The groups are organized homogenously and within the group each pupil has the same task. Group members do not necessarily have to co-operate; they may be given tasks that they carry out individually, independent of each other. In cases like this larger groups can be made.

However, if the task requires the group members to co-operate, groups should not have more than 3 to 5 pupils. This organisational form is particularly suitable for work with gifted children or in situations when some pupils need to catch up with the rest of the class.

Differentiation according to content

Children are divided into homogenous groups according to ability. Since the members of the groups work individually, there is no need to have small (3-5 members) groups. Each pupil does their task independently, in a partly personalized way.

Organizational groups

- Cooperation among the members
- 3-5 member groups may be either homogeneously or heterogeneously organized
- Group members do the same task
- The work of group members with different abilities differs in content

Differentiation in the learning requirements

This form of differentiation facilitates the integrating of pupils with learning difficulties or other skill-dysfunctions. Pupils are divided into groups according to their abilities. Curricular requirements for these pupils are different from the general requirements for the rest of the class. These pupils do their tasks independently or cooperatively with their group mates.

Basic principles of differentiation

Knowledge of the different methods

In order for these varied forms of organization to prove effective the teacher must be familiar with the aforementioned concepts, must know how to use them, must be aware of the advantages that may derive from their application, and must be able to handle the problems that might occur during the teaching process.

The approach

This way of teaching can be really successful if the teacher keeps a grip on the multi-level learning process and copes handling it.

Aspects of the differentiation

The organizational forms are always determined by the following:

- Content of the subject
- Educational requirements and the methods of instruction
- Individual needs of the pupils

Flexibility

Differentiation must not be a reason for labelling or selection. Everyone should get the amount of workload which is optimal for him/her at the given time.

Organizational forms in learning

Group work

The role of the size of the groups

The smallest group must consist of at least 3 members because a smaller number would mean pair work or individual work. Ideally, a group has 4 members, as this way each member can have their own sub-task; furthermore, the group can easily be divided into pairs, should it become necessary. Groups with more than 6 members are very difficult to manage, therefore some of the pupils may choose not to get involved in the work, or even disturb the others.

Aspects of the arrangement of the homogeneously and heterogeneously organized groups

Homogeneously organized groups are characterized by the following:

- In the given subject pupils are almost on the same level as far as their abilities and interests are concerned.

Heterogeneously organized groups are characterized by the following:

- Differences are more emphatic among the pupils' interests and abilities in the given subject.

In the latter case it might be useful to assign roles to ensure that each member is involved in the work, according to their own abilities. This type of group work justifies the theory that pupils can learn from each other most effectively.

Roles within a group

Effective cooperation is based on the equal division of labour and mutual responsibility. This can be achieved by assigning individual group members certain roles/tasks.

Assigning tasks and responsibilities in a group may have a double effect:

On the one hand it reinforces the existing social skills. On the other hand it creates and improves further ones.

Since the pupils cannot be expected to be able to organize group work independently in the beginning, it is useful that the roles (manager, note taker, drawer, and reporter) are assigned by the teacher. This way you save time on the one hand, on the other hand you ensure that each child is assigned a job that is the most suitable for their abilities. However, pupils should get a chance to try themselves out in new roles as well. (E.g. The pupil who usually assumes a leading position must learn to show respect and co-operate when someone else is in charge, while shy pupils should try speaking out in public.)

Although the particular roles are not so important for pupils in the upper grades, still it may be useful to assign subject-specific roles to develop responsibility.

The ways of forming a group

A group may be formed randomly, according to the pupils' personal choice, or consciously arranged by the teacher. Obviously, the latter will enable you to best reach your didactic goals, since this is where all the conditions are provided for a successful co-operation:

- Ability and knowledge
- Personal sympathy
- Balance of the genders
- Ethnicity

The advantages of group work

Well-organized group work profoundly influences the personalities and scale of values of the pupils:

- Thinking together
- Ability to adjust
- Co-operation
- Argumentation/persuasion
- Respect to others, tolerance of different opinions
- The experience of belonging to a group

Pair works

The concepts of “pair work” and “Pairs who learn together”

- During pair work, two pupils with similar abilities carry out a task co-operatively. This is a homogeneous pair.
- In the case of pairs who learn together one child has weaker abilities than the other. The pupil with the better abilities acts as a “teacher” (teaching while learning). This is a heterogeneous pair.

Points to consideration when forming pairs

In an ideal case pupils like and support each other.

Types of pairs

The cooperative pairs may carry out several functions (reading, writing, counting, thinking).

Ways of forming pairs

A pair may be assigned to work together permanently or temporarily, or related to a subject (E.g. mathematical pairs)

Pair work or group work?

Experience shows that pupils between the age of 6 and 10 work most effectively in well organized pairs (see the above mentioned points) where the two members co-operate on an equal basis.

*Individual work***The concept of individual work**

Each pupil has different abilities and an individual style of learning. This fact must be taken into consideration, especially in the case of pupils with particularly weak or particularly strong abilities. A plan which is made to develop an individual pupil's skills is called individualization. It is particularly useful for work with gifted children or in situations when some pupils need to catch up with the rest of the class.

The differences between independent and individualized work:

Independent work can be done individually, in pairs, or in groups. The main point is that the pupils work independently. In case of individualization the task is tailored to fit the needs of the individual.

Partly individualized work

- All the pupils who happen to be on a similar level, do the same task independently.
- The differences between partly individualized work and group work: partly individualized work is done independently, without cooperation; while group work is characterized by co-operation.

Differentiated processing of the material with worksheets

How to create a worksheet for a learning process that takes place on 3 different levels?
(*, **, ***)

level 1	level 2	level 3
<ul style="list-style-type: none"> • Easier • Simpler • Less information • More pictures and demonstration • More playful • Bigger size of characters if necessary or words may even be divided into syllables 	<p>A worksheet compiled for the "average" pupil (According to the didactic goals of the particular lesson it might be used for presentation, revision, practice, re-cap, etc.) It is to be used by the whole class in frontal work.</p>	<ul style="list-style-type: none"> • More difficult • More complex • More information (mainly verbal) • More difficult, sophisticated wording • Perhaps smaller size of characters

Preparing tasks to keep pupils busy

Pupils who do different tasks in different organizational forms will, of course, never finish work at the same time. The "idle breaks" that occur here are what many teachers dread. The aim of this module is to provide you with some examples for brief tasks and to show how to create similar tasks, to enable you to prevent your pupils from idling and use these breaks to develop their abilities or help them catch up on work.

The types of exercises that keep pupils busy

- Interesting exercises, games to supplement the new material → caring for talents
- playful exercises to provide extra practice → catching up with the rest of the class
- Simple, short exercises for the average pupil to process the given material

The exercises that keep pupils busy should be

- Short (not time-consuming)
- Marked level of difficulty (give a real sense of achievement)
- Playful and interesting (motivating for pupils)

The phases of constructive education

- *Arousing interest:* By choosing a topic that arouses the interest of the pupils and may even generate clashing opinions.
- *Forming groups:* Creating diversity within in the groups (abilities, gender and ethnic background)
- *Team development:* Finding common features and shared views that strengthen the cohesion in a group
- *Choosing a topic:* The given topic is divided into smaller sections by the class and each group has its own subtopic so everyone's work is needed to accomplish a result
- *Further dividing of the given topic:* The subtopics are divided further by the group and each member is responsible for their own mini-topic.
- *Elaboration of a subtopic:* The pupils collect and elaborate the material of their own mini-topics independently. They are allowed to help each other so everybody can get a real sense of achievement.
- The members discuss their subtopic in the group.
- *The preparation of the joint report by the group:* The members of the groups argue, persuade and support each other during their work together.
- *The report of the group about the subtopic:* The groups report the results of their work to the class.

Evaluation:

- The groups evaluate the reports about the mini-topics
- The class evaluates the report
- The teacher evaluates the reports and the projects of the groups
- *The overview of the results of the work:*
How did the individual pupils contribute to the learning process of the group?

Recommended types of lessons

- Processing new material
- Practice
- Revision, Assessment, Diagnostic measurement

Types of tasks

- Problem-solving tasks for groups
- Creative tasks
- Observation/research tasks
- Argumentation, discussion
- Check, evaluation

Organization of cooperative learning

Co-operative pedagogy aims to use methods that make the learning process a social activity. The main point is the cooperation of the pupils as a peer group. There are numerous cooperative educational and learning methods (project method, discussion, problem-based and observing learning etc). You can find a smaller or bigger collection of cooperative techniques, exercises and recommendations to any of these methods. There is no single correct co-operative method but there are several cooperative techniques, what's more, there are hundreds of exercises and techniques available these days. So without committing yourself to one or the other method forever, you can choose a solution that is appropriate in the given pedagogical situation, and apply another technique in another situation.

Problem-based learning

Beyond conveying knowledge, this technique aims to develop pupils' skills in problem solving and cooperation. Problem-based learning requires independent research by the pupils, their ability to spot the essence of a matter, and some IT knowledge; it also aims to develop these skills. The teacher plays the role of a coordinator or advisor. Problem-based learning teaches pupils how to learn. The pupils learn cooperatively in groups, searching for solutions to problems of the real world. At the same time they learn how to coordinate their own learning process in the most effective way. The main point of the method is to use one's own skills to achieve knowledge rather than act as a receptacle for ready-made knowledge. In classes where the pupils use this method, they realize how learning becomes a process of search for knowledge. The pupils develop a critical way of thinking, which enables them to link the information they read with the purpose they can use it for. The success of problem-solving and the success of the learning process depend on the effective activity of the pupils at and outside school. Doing the tasks in a group saves time and develops the social and verbal skills of the group members, too.

Problem-based learning is a novel technique that uses constructive pedagogical methods to present new material in the form of a problem that needs a solution.

The basic steps of applying this method:

- a) Definition of the task
- b) Strategies for information search
- c) Definition of data and information access (where)
- d) Use of information and problem solving
- e) Synthesis
- f) Evaluation

Cooperative discussion

This is a good way to develop pupils' communicational and rhetorical skills.

During the discussion all the participants have a chance to talk (provided the rules are obeyed).

Phases of the technique are the following:

- a) The moderator of the discussion makes controversial statements related to the subject.
- b) The sentences are displayed in the room.
- c) Each pupil stands under one of the statements, according to their opinion/feelings.
- d) After arranging the groups for the discussion the moderator sets a time limit for collecting the **pro** arguments.
- e) After collecting the arguments each group choose their own spokesperson.
- f) The spokespersons sit around a table and get so called discussion chips (3-6 pieces, depending on time and the number of participants).
- g) The group members stand behind their spokespersons and also get chips. The function of these chips is to allow the pupils in the background to get involved in the discussion. Alternatively, the group members may give their chips to the spokesperson if s/he has run out of his/her own but has some more arguments to present.
- h) If a spokesperson puts forward one of his/her arguments, they must place a chip in the middle of the table. The chips determine the number of utterances. One argument costs one chip. By using this technique the teacher does not only control the length of the discussion but teaches pupils to word their arguments precisely and concisely.

Drama as a teaching technique

Creative drama is an attempt to personalize knowledge.

The key concepts are **role** and **identification**. This means that the pupils play a role and they try to imagine what they would do in a certain role or situation. Depending on the task they may be themselves in a certain situation or they may have to play a character with certain features. But even in the latter case the pupil's own personality interacts with the character they need to identify with. That's how, in an ideal case, they can understand the problem through their own experience.

Different situational exercises require different levels of empathy. E.g.:

- a) Simple exercises for improving empathy
- b) Dilemmas, decision making
- c) Joint decisions
- d) Developing a set
- e) Dramatization of well-known stories
- f) Situation games
- g) Simulation
- h) Tableau/Group of photographs
- i) Trial
- j) Dispute

The place of drama in the learning process

The question arises, not only about drama, but about any technique based on an activity: should it precede or should it rather follow the presentation of the new topic by the teacher (provided such a presentation does happen in the lesson at all)? According to the traditional view drama is just a game that should only start when the serious work is finished; moreover, it is impossible to act something out before the facts are learnt by the pupils. Sometimes it is true, sometimes it is not. In many cases “acting out” is not interesting anymore when the pupils know exactly how they are expected to act.

Whereas if pupils act out a certain situation, they can get their own personal experience to relate to the newly acquired knowledge.

Cooperative learning according to Kagan

“Cooperative learning” by DR SPENCER KAGAN was published in 1985 (San Clemente, CA: Kagan Publishing). This book is the most complete and most recent collection of cooperative techniques. The book is not related to any other method; it is known as the Kagan-method. It is a method-based collection sorted mainly by skills. The Kagan method is based on co-operation and makes an effort to take individual differences into consideration.

The teaching-learning process has a double aim:

- *The aim of the given subject:* to develop cognitive skills based on the teaching material.
- *The social aim:* First, pupils are given responsibilities. Second, the teaching material is learnt in different organizational forms, which are based on cooperation, so the pupils’ social skills develop as well.

Cooperation-based learning is the highest level of learning in a group. In this organisational form the members of a group are greatly reliant on each other, consequently pupils also learn social skills here, while acquiring the strictly subject-related material. The teacher does not expect (require) the pupils to possess these skills; instead, s/he facilitates their development, using various co-operative techniques.

As opposed to Kagan, traditional group work requires less close cooperation, and success does not necessarily depend on the contribution of all the participants.

The organization of the learning process has 6 key elements.

A group

- A cooperative group consists of 3-6 permanent members. There is a strong coherence among the members; they know, accept and support each other.
- *It is a heterogeneously arranged group:* by ability, gender, sympathy and ethnic background
- *Ways of forming the groups:* random or conscious
- Responsibilities in a group e.g.
 - *A note taker is responsible* for correctness of speech.
 - *A time keeper is responsible* for keeping the time limit.
 - *Someone who is in charge of work* ensures each member does their job well, and maintains effective communication within the group.
 - *A spokesman* is responsible for keeping in touch with the teacher, reports about the work done by the group and presents the completed task.
- Assignment of tasks within a group, organization of the work, definition of the technique to be used. (e.g. "Round table", Word rotation", "Mosaic" etc.)

Class management

- The classroom must be arranged in such a way that pupils are able to contact any of their group mates easily. You should have a conventional sign or symbol (on which the class have previously agreed) to control the noise level during group work.
- In order to provide the conditions for smooth and successful work, the place of tools and the location of work should always be unchanged.

The intent of cooperation

There are three ways to develop and preserve the pupils' intention to cooperate:

- Developing a community (group, class)
- Cooperative tasks
- Using a system of rewarding and evaluation

Willingness to cooperate

Several activities may be used to develop the social skills:

- Modelling sg.
- Joint interpretation
- Role play
- Observation
- Backing each other up
- Defining/assigning responsibilities

The basic principles of cooperation-based learning

Unless all of the following principles are adhered to, cooperative learning does not take place. The four basic principles (acc. to Spencer Kagan):

- a) *Parallel interactions*: There is multiple interaction during the learning process among the pupils. So the time of active participation of each individual pupil is much more than it would be in a traditional class.
- b) *Personal responsibility*: Each of the pupils must complete his/her share of work to contribute to the work of the group. The individual reports to the group. Peers know about everyone's contribution, and each individual is responsible for a certain share of the task.
- c) *Constructive interdependence*: Individual development and the development of a group will positively affect each other, if the development of a pupil requires the others to develop, if the success of one group means the success of another group at the same time.
- d) *Participation in equal proportion*: The pupils take part in the work according to their ability. This aim can be reached by division of labour and assigning tasks.

Techniques

Each of the cooperative techniques has a place under the sun, since each of them is suitable for a different situation.

Points to consider when choosing a technique:

- Time allocated for work
- Forms of activities
- Type of lessons
- Content
- Measure of interdependence

According to the previously mentioned, here are some examples for cooperative techniques that are intended for use for different activities:

a) A technique for forming a group

A human mosaic: a random technique for forming a group. Pictures are cut into many pieces according to the number of people in a group. Everyone gets a piece of the picture. Pupils must swap the pieces among each other. Everyone must swap at least once. Then they have to find each other to complete the picture. The groups are formed randomly this way, but if you write the names of pupils on the back of the pieces of the picture, this technique can be used purposefully to form a group.

b) A technique to help process a new topic

Interview in 3 steps

The teacher gives the members cards with the letters **A, B, C, D**. Each one gets a different text and exercise.

Every group member reads their own exercise and text, and takes notes.

4. Pupil "A" tells pupil "B" about his/her text while "C" talks to "D" about his/her text.
5. "B" tells "A" and "D" tells "C" what they read about.
6. *Gossip*: "A" tells "C" and "D" what he/she heard from "B", then "B" tells what he/she heard from "A". Then "C" repeats what s/he heard from "D" and "D" repeats what s/he heard from "C".

The members of the group take notes or listen to the others so all four members familiarize themselves with each of the passages.

c) Technique for recapitulation and systematization

Round table

This technique is good for:

- preparation for presentation
- checking whether pupils have understood certain information
- brainstorming
- testing pupils
- practicing

The group members use a sheet of paper and a pen. One of them writes something and passes the paper and pen on to the person on his/her left. The tools are simply passed around, hence the name "round table".

d) Techniques of assessment and evaluation

Sending an exercise - quality control and evaluation in a group

Each group sends a question to the others (after consensus) and after some time they send the correct answer, too. The groups check themselves.

According to Kagan we can only talk about cooperative pedagogy provided all four basic principles are present in a technique.

Pedagogical project

A complex, usually everyday-life issue; defining the aims and tasks related to the processing of the issue; planning the working process and the results; presentation of the results

The project method is a special learning unit that centres around a problem.

The task is not only to solve or choose the problem, but to disclose the most possible aspects that are organically connected to the given problem in real life. Each project is unique and endless, because the problems are not abstract concepts, but come from reality.

There aren't any two identical projects because the participating pupils, the teachers and the circumstances are different.

The project method requires conscious planning of the pupils' activity. The planning must go on two different levels. The first level concerns the whole process, in the course of which we intend to teach certain knowledge and develop certain skills. The second level means the planning of the individual projects, which requires motivation and help from the teacher.

It is important that verbal skills do not dominate here, and pupils with different skills take an equal part in the solution of a problem they have chosen together.

Although the differences in the teacher's and pupils' roles are maintained, the co-operative character of the method is ensured by the fact that the teacher's leading role is most unobtrusive, with him/her acting merely from the background, and is realized through joint planning, action and evaluation.

The wide variety of tasks gives pupils a chance to participate in the work in many different ways. Pupils can choose their own share of work according to their previous experience, talents and ambitions, without any special methodological effort from a teacher.

The project method goes beyond the framework of traditional education and school. It focuses on problems of everyday life and relies on the participants' experiences.

The working process of the project:

- a) Choosing topics and discussing them
- b) Choosing and assigning subtopics (led by a teacher or by consensus)
- c) Choosing communication channels (e-mail, forum)
- d) Planning a communication strategy (frequency of information transfer, deadlines to check the reports on minitopics)
- e) Talk and presentation about the minitopics in groups
- f) Preparing the presentations by the groups : "sawing together" the reports on the minitopics
- g) Presentations of the groups
- h) Comments, evaluation:
 - *Evaluation in groups:* minitopics
 - *Evaluation in class:* Evaluation of the group presentations

Comparing traditional pedagogy to constructive pedagogy

Personal conditions

The teacher's point of view

It is essential for the teacher to know the importance of cooperation and differentiation.

- **Knowledge of the content of organizational forms**

These varied methods can be successfully used only by those teachers who are familiar with the concepts, the rules of use, the advantages and the possible difficulties, and are prepared to handle the problems which may occur during the teaching process.

- **Attitude**

The teacher should not pose as "the source of all information and knowledge"; s/he should stay in the background and control pupils' activities in an indirect way.

The cooperative and differentiated way of work should not be a difficult or exhaustive task for the teacher. This way of teaching can only be effective if the teacher keeps a good grip on and is able to manage the multi-level teaching process.

• **Teaching experience**

The adaptation of the knowledge to the skills of your pupils requires a great deal of experience and theoretical knowledge from the teacher.

The key stone of this method is the active participation of pupils during the teaching-learning process, therefore the teacher's work consists mainly of lesson planning, organization, and providing the necessary tools.

• **Points to consider when using the cooperative method**

Organizational forms should be chosen according to the content and the methodological needs of the education as well as the needs of the pupils.

• **Flexibility**

Differentiation must not be a reason for labelling or selection. Everyone should get the amount of workload which is the most optimal for him/her at the given time.

Types of pedagogical tasks in the learning process:

Aspects	Frontal lesson	Cooperative lesson
Style of preparation	Review the topic: <ul style="list-style-type: none"> • A logical lesson plan • (Audio) visual aids • Questions, possible answers • Checking the logical structure of the lesson • Planning a one-track interaction 	Review the topic – how to make it cooperative: <ul style="list-style-type: none"> • Division into four parts • Which parts can be processed individually? • Writing texts • Making visual aids • Preparation of tools (Buying wrapping paper, markers) • Photocopying • Planning multilateral interactions • Checking the lesson plan against the four basic principles
Preparation time	Probably less	Probably more
Further usability	Probably it will be completely recyclable	Probably only some of the elements will be recyclable (texts, aids)
Beginning of lesson	Motivation: getting the interest of pupils in some way	Rearranging the furniture, if necessary (if the room is not arranged for cooperative learning) Forming groups Motivation: builds on the background knowledge of pupils Handing out the “cards of responsibility” and assigning responsibilities: who is in charge of what?

Support during the lesson	Explanation, question, answer frontally, joint discussion	Assisting small groups, and individuals (personal style)
Movements of the teacher	Little movement, may be stationary in a conspicuous place by the blackboard	Teacher walks among groups, bends towards a pupil, may work together
Voice	Everybody should be able to hear, so it must be loud	Speak in a low voice; personal tone
Distance	Formal	Informal/social
The most needed features	<ul style="list-style-type: none"> • Good rhetoric skills • Effective communication to keep the attention of pupils • Be a good disciplinarian • Be prompt in repartee • Accuracy • Intelligibility • Explanative skills • Display a gift for “acting” • Continuous concentration (must not say anything incorrect or incorrectly) 	<ul style="list-style-type: none"> • Good organization skills • Firmness • Good sense of time • Good communication skills • Divided attention • Ability to adapt oneself to the message of pupils • Open-minded personality • Creativity- mainly in organization and activating pupils
Evaluation	<ul style="list-style-type: none"> • Evaluation of the achievement of individuals (oral tests, written papers) • Evaluation of the behaviour of the whole class 	Evaluation of different groups, a range of methods for assessment of individual and group achievements Development of social skills

The pupils' point of view

Besides acquiring knowledge, pupils have a chance to practice empathy, independent thinking, patience, tolerance, a responsible and supportive attitude; furthermore, they improve their communicative skills, cooperative skills, organizational skills and adopt a supportive and creative attitude.

- Consequently, the teacher's responsibility lies in the careful preparation and management of the lesson, and the in the choice of the topic and the most appropriate teaching method.

This should manifest in indirect control and personalized assistance, so the teacher can at any time give his/her attention to those pupils who need it most at that moment. At the same time pupils working in pairs or in groups constantly have a chance to evaluate and analyze their own work and the work of their peers. This way it is also possible to differentiate within the groups.

EFFECTIVE TECHNIQUES FOR THE ORGANIZATION OF LEARNING

The two different ways of learning require pupils with different characters:

Frontal teaching	Cooperative learning
Doesn't mind being controlled	Independent
Competitive	Cooperative
Quiet	Has good communication skills
Pays attention to him/herself	Good organizer
Having self-control	Self-restraining behaviour
Conformist	Creative
Patient, able to pay attention to a teacher	Patient able to pay attention to his/her peer
Takes things with resignation	Tolerant
A person short of ideas	Has initiative
Responsible for him/herself	Responsible for others
Ambitious	Helpful

Differences between traditional and constructive pedagogy:

	Traditional	Constructive
Teacher	A judge, a speaker, an expert	Trainer, instructor, expert, learner
Pupil	Passive, listener, a reproducer	Active participant, constructive
Content	Divided into subjects, abstract, comprehensive	Integrated interdisciplinary, authentic
Evaluation	Selective qualifying	Diagnostic, portfolio-based
Learning environment	Big steps, little interaction, few sources of information, many instructions	Small steps, a lot of interaction
Didactical	Didactical triangle: a teacher, a pupil and the subject	Didactical polygon - a teacher, peers, task, media, a discipline

The question of testing and evaluation

In the case of the constructive methods of learning evaluation by the teacher as well as pupils' self-evaluation is characterised by asserting the positive features, emphasising the achievements.

A differentiated, executable task, which takes individual skills and abilities into consideration, enables a pupil to learn without failures. At the same time we should not leave the actual capacity of the particular pupil out of consideration. Namely, to what extent did s/he use his/her abilities in order to fulfil the task?

Mistakes are discussed and corrected together. Making a mistake is considered to be part of the learning process. It gives the children some kind of security and relieves pupils from stress.

During the evaluation process the teacher should:

- Not just evaluate but record the stage of development
- Assess the improvement of the pupil compared to his/her previous achievements
- Point out to what extent the pupil has used his/her own abilities

Aspects of the evaluation are complex and focus on the development of the personality of a pupil rather than a subject.

These aspects include the assessment of:

- Factors influencing the process of learning
- Levels of different learning techniques
- Communication and reading skills
- Counting and mathematical skills
- Artistic and kinetic activities

And the most important features of the pupils'

- emotional life
- and social relationships.

II. TASKS

Geography

Take photographs of the stellar sky (to demonstrate gyration)

If your students take photographs of the starry sky with a camera set on a tripod, and the exposure time is set to 1-2 hours, then the seeming movement of the stars can be beautifully illustrated. It is a good idea to position the pole star in the middle, to show that this star stays still, which means that the spin-shaft of the Earth is currently pointing to this distant star. The apparent motion of the stars will be shown in the picture in the form of small concentric circles. This kind of picture can be best taken in areas that are far away from city lights: on a night tour or during school trips. In the summer, darkness falls later, but weather conditions are better, than in winter, when pictures can be taken as early as 5:00-6:00 PM. The photos can be printed out or projected to show in class.

Recommended software:

For taking pictures at specified time intervals from a Webcam: *Webcam Timershot*

<http://download.microsoft.com/download/whistler/Install/2/WXP/EN-US/TimershotPowertovSetup.exe>

For editing photos and creating slideshows: *Photo Story 3*

<http://www.microsoft.com/downloads/details.aspx?FamilyID=92755126-a008-49b3-b3f4-6f33852af9c1&DisplayLang=en>

For creating movies from photos and videos: *Movie Maker 2*

(The Windows Movie Maker 2.1 is part of Windows XP Service Pack 2)

For creating presentations: *PowerPoint*

Display the shifting of water levels on a river or creek

If there is a nearby water-course, even a small creek, then the change in the water levels can be nicely illustrated by comparing photos taken from the same aspect. When taking the pictures, make sure you take them from the same spot and the same angle. Due to the climate of our country - on the borderline of dry and wet continental - waters keep changing their level: you can see low, medium, high water levels as well as floods, therefore by taking just a few pictures your students will still be able to demonstrate great differences. If a lot of pictures - with the same settings - are taken, then projecting them quickly after each other will produce a captivating effect.

Recommended software:

For taking pictures at specified time intervals from a Webcam: *Webcam Timershot*

<http://download.microsoft.com/download/whistler/Install/2/WXP/EN-US/TimershotPowertovSetup.exe>

For editing photos and creating slideshows: *Photo Story 3*

<http://www.microsoft.com/downloads/details.aspx?FamilyID=92755126-a008-49b3-b3f4-6f33852af9c1&DisplayLang=en>

For creating movies from photos and videos: *Movie Maker 2*

(The Windows Movie Maker 2.1 is part of Windows XP Service Pack 2)

For creating presentations: *PowerPoint*

Measure the daily alteration of air-temperature

If there is no weather front nearby, the daily alteration of air-temperature shows a regularity: the coldest is dawn and the warmest is early in the afternoon (around 2:00-3:00 o'clock PM). This can be understood and demonstrated, if the students measure the temperature hourly under the same conditions (e.g. in shade). Students may collect the data while in a camp, on a school trip or at home at the weekend. Only collecting information at night might cause a problem, but students could be asked to take turns to undertake the duties for a few nights. With the collected data, diagrams can be made and if there are data available from different seasons, then comparing the seasons will also be instructive.

Recommended software:

For creating spreadsheets: *Excel*

Use your own pictures to make a presentation about a country, region or some sights you visited during a summer holiday

Nowadays more and more people take photos, so there is always a pupil who has taken lots of pictures – even if with the help of their parents – on a holiday. Using these pictures and scanned maps, students may make a presentation on famous sights and even personal experiences. It is the most educational if this procedure takes place when the class is learning about the particular country or region concerned, but it can also be done as a reward after a test...

Recommended software:

For creating presentations: *PowerPoint*

For creating web pages: *FrontPage*

Make a homepage for a geographical display about the local environment

Local environment can be a district, parish, the neighborhood or a nearby natural formation (e.g. lake, swamp, mountain or basin...). The preparation of the homepage might be done using any homepage-making model, which is easily available nowadays, or you can use your own designs and IT knowledge. If a whole class creates one homepage presenting a certain geographical environment, then the groups ought to distribute the aspects among themselves,

and one group should assume standardization, but if each team creates their own website – even about the same place – then each team should appoint one member who will be responsible for the task of collecting and uploading their material.

Recommended software:

For creating web pages: *FrontPage*

Create a notice-board or display about volcanism

The notice-board can be made individually, but considering the benefits of co-operation and division of labour, it is perhaps better done in small groups; it is also more effective and faster this way. This topic is really broad, so the teams should either narrow it down to a smaller topic independently, or they could choose from set sub-topics (e.g. types of effusive rock, volcanic activity, the eruption of the Vesuvius ...). Although there is plenty of information about volcanism in books, papers and on the internet, problems can occur when collecting and presenting data, due to the limited space available on the notice-board. This means a smaller amount of pictures and text need to be selected. Spectacular pictures and self-made graphs, illustrations enhance the value of a display like this.

Recommended software:

For creating cards: *Word, Publisher*

Gather information about the most devastating earthquakes in the last few years

Data about the most destructive earthquakes in the recent years can not only be found in books; now the most up-to-date information is on the internet. There could be only one problem: different sources sometimes have different data.... Hopefully, there won't be too much discrepancy, though. While gathering data, students will need to visit a lot of websites, and jump from one to the other. The collected information can be sorted in many ways: according to property damage, number of casualties, or even by date or region. Well arranged charts and data-bases can be made.

Recommended software:

For creating spreadsheets and diagrams: *Excel*

Show the vertical alteration of air-temperature with the help of calculation and graphical representation

This type of exercise – in which the alteration of air-temperature is studied, while the air may be stationary or rising, above dew point or under it – sometimes poses a problem for students. Graphical representation can solve this problem, as the procedure of calculation and graphical

illustration together are more expressive, especially if there is an opportunity to project the animations in class, and discuss each step together.

Recommended software:

For creating presentations: *PowerPoint*

For creating spreadsheets: *Excel*

Make a calendar using pictures of sights taken on a school-trip

Using their photos taken in a summer camp, on a school trip or field-trip, the group creates a picture calendar. Students may learn to use calendar-editing programs, or alternatively, they can also design and write the whole calendar on their own, without these programs. The best calendar(s) - if funding is available - may be printed and stitched together and be used in deed.

Recommended software:

For creating documents: *Word, Publisher*

Make a map of the surroundings of the school

With the help of computer-programs, the group makes a map of the neighborhood of the school. Data may be gained by measuring, but old maps and aerial photographs may also be used if available. Of course, the work has to meet the requirements of a real map, e.g. it has to be precise, perspicuous, neat, has to include the scale of shrinking etc.

Recommended software:

For drawing: *Paint*

Display rocks using a Webcam and a projector

When demonstrating the features of rocks to a whole class, one option can be to use a well-adjusted web-camera. This way it is certain that each student has an unhindered view of the specimen. The samples can be shown from different angles, and you can point out typical parts, refracting surface, minerals, and fossils. Of course, this doesn't replace the experience a rock gives when the students can hold it in their own hands.

Create maps

Make a map of the route from your home to your school (or a part of it, if you live really far) with Paint! Put exclamation marks on the places, which are especially dangerous from the point of view of traffic.

Recommended software:

For drawing: *Paint*

View from above

Visit the website of **Terraserver!**

<http://www.terraserver.com>

Search for satellite pictures of your city! Try to mark your house, school, and the route you follow between them!

Recommended software:

For drawing: *Paint*

Virtual tour in a Zoo

Set up a walk in a zoo for your friend with the help of the map on the homepage of your local zoo. Choose a habitat you want to introduce! Find the paddocks/cages which have got animals that live in the habitat you have chosen. Modify the picture with *Paint*, and mark the route to be followed.

Recommended software:

For drawing: *Paint*

My Zoo

Make a presentation of “your own zoo” with *PowerPoint*! Search for pictures, sounds, short videos on the internet! Use the local web search or the local web catalog, where with just one click, you will find special sounds and videos, too.

Recommended software:

For creating presentations: *PowerPoint*

Card

Make cards about animals in *Word*! On each card, next to the animal’s picture, type its taxonomical classification, habitat, average height and weight, as well as its speed. Search for data on the internet! The size should be suitable for playing, too. Print your cards!

Recommended software:

For creating cards: *Word, Publisher*

Solar Eclipse

Make a model of a solar or lunar eclipse with *PowerPoint*! Search for pictures and data on the internet! For animation use individual animation!

Recommended software:

For creating presentations: *PowerPoint*

Where to go on holiday

Form groups of 3 or 4 in the class. Choose an area or a tourists' attraction, where you would organize a trip. Find information about the place on the internet, and make an 8-minute presentation, which includes the following points: what you would see, what kind of historical/geographical/biological references that place has, how much it would cost, how you would get there etc.

Recommended software:

For creating presentations: *PowerPoint*

Water-levels

Look up the water-levels of a river in the last 5 years on the internet! Copy the data for the first and 15th day of every month into Excel, and make a graph! Compare the graphs within the class. Why do different rivers change differently? Which were the wettest and driest periods/years? What is the cause of this? Make a presentation based on your graphs!

Recommended software:

For creating presentations: *PowerPoint*

For creating spreadsheets: *Excel*

Atmosphere

Make an animated presentation to demonstrate what process takes place, if harmful gases (e.g. CFC) get into the upper-atmosphere. Include the equation of the reaction.

Recommended software:

For creating presentations: *PowerPoint*

Residence

Take photos and make short videos of your home with a digital camera! Gather information about the sights featured in the photos! Make a 4-6 minute presentation about your home, with the help of Producer and PowerPoint! The narration can be made with a simple microphone, even subsequently.

Recommended software:

For creating presentations: *PowerPoint*

For turning the presentation into a movie: *Producer*

<http://www.microsoft.com/downloads/details.aspx?FamilyId=1B3C76D5-FC75-4F99-94BC-784919468E73&displaylang=en>

Geological Periods

Make a comparative chart or data-base of different geological periods. Include several aspects (the more the better). Apart from the lessons, Encarta Encyclopedia, which contains a lot of information about the flora, fauna and events of the periods, can be used as a useful source.

Recommended software:

For creating spreadsheets: *Excel*

For collecting data: *Encarta* <http://encarta.msn.com/default.aspx>

Temperature album

Make an album which contains the geographical, biological and social features of a certain climatic zone.

Recommended software:

For creating documents: *Word, Publisher*

Sunny Hours

Why are some days longer than the others? Why do seasons keep changing? Why do Americans wake up at different hours than we do?

Visit <http://www.amnh.org/education/resources/rfl/web/antarctica/seasonal.html>

to watch or download the video, which demonstrates the revolution of the Earth.

Recommended software:

For watching the video: *Internet Explorer, QuickTime Player*

A rainy day in...

Students get into groups and look at the tourist websites of their capital (or a smaller, famous town of their country), offering programmes and introducing the famous sights. They collect information on sights and possible activities. They will probably find plenty of information which would be suitable for outdoor sightseeing tours for a tourist group on sunny days. But this time their task is to sort out the ones they would offer tourists to do on a rainy day in the city.

They make a list of the sights and things to do, collect pictures, maps and other information on them. Using these items, they design a leaflet including itineraries, maps, teasers, pictures, etc. The leaflet should be suitable for giving it out to real tourists, so it should be informative, clear and attractive, offering a wide range of activities.

When they are finished, they organize a "travel fair" in class, trying to sell their programmes to "customers". If it is suitable, other classes can be invited to the travel fair to make it more realistic.

Further possibilities:

- If it is possible, the group which has “sold” the most tickets for their tour organizes a real sightseeing tour in the city, based on their own programme.
- If the leaflets are good enough, students might want to take them to the local tourist office to show them to the authorities.

Recommended software:

For getting information: *Internet Explorer*

For creating documents: *Word, Publisher*

Weather report

To learn and practice the vocabulary of ‘weather’.

Students look at the map of their own country or an English-speaking country and (if the country is big enough) choose a region.

In pairs or groups, they search the Internet for the region’s up-to-date weather forecast as precisely as possible.

<http://www.weather.com/>

<http://weather.yahoo.com/>

<http://www.bbc.co.uk/weather/>

<http://www.cnn.com/WEATHER/>

One pair or group may want to collect information on the road conditions for the country, another on the medical effects of the forthcoming weather.

Using the collected information they create a PowerPoint presentation, and then the groups take turns to present a weather report in front of the whole class.

Recommended software:

For getting information: *Internet Explorer*

For creating presentations: *PowerPoint*

Biology

Use slides to illustrate the stages of germination

Students need to observe the germination of a plant (for example a bean) for about 10 days to take good pictures from the rising of the seed until the sprouting of the first true leaves. The seed must be placed either on the surface or under a very thin layer of soil. One picture per day is sufficient. If the adjustments of the photography (viewing angle, shutter speed) and the illumination circumstances are the same every day, with the proper software a lovely “motion picture” can be made of these pictures. If you have “movies” of various plant species, you can analyze the differences in germination.

Recommended software:

For taking pictures at specified time intervals from a Webcam: *Webcam Timershot*

<http://download.microsoft.com/download/whistler/Install/2/WXP/EN-US/TimershotPowertovSetup.exe>

For editing photos and creating slideshows: *Photo Story 3*

<http://www.microsoft.com/downloads/details.aspx?FamilyID=92755126-a008-49b3-b3f4-6f33852af9c1&DisplayLang=en>

For creating movies from photos and videos: *Movie Maker 2*

(The Windows Movie Maker 2.1 is part of Windows XP Service Pack 2)

For creating presentations: *PowerPoint*

Present plant species native to your close environment

The students’ task is to present a number of plant species native to their close environment (school yard, nearby forest, meadow). It is difficult to introduce even a herbaceous plant in a single picture, not to mention a huge arboreal one! Therefore students should take a series of pictures of each plant to show the plant’s shape, leaf, possibly the flower and the seed as well. The easiest way of presentation is to project your pictures on a screen.

Recommended software:

For editing photos and creating slideshows: *Photo Story 3*

<http://www.microsoft.com/downloads/details.aspx?FamilyID=92755126-a008-49b3-b3f4-6f33852af9c1&DisplayLang=en>

For creating movies from photos and videos: *Movie Maker 2*

(The Windows Movie Maker 2.1 is part of Windows XP Service Pack 2)

For creating presentations: *PowerPoint*

Take your pulse rate after exercising, and make diagrams

When the students measure their own pulse rate after various numbers of crouching – for example in the beginning, in the middle and in the end of the lesson – the data could be analyzed in several different ways. For example they could be sorted and averaged, according to whether

they are from an athlete or not. The relationship between the pulse rate of an individual and the amount of the physical exercise taken can be graphically displayed using computer software. You can print or project these graphs with a projector or overhead projector.

Recommended software:

For creating spreadsheets and diagrams: *Excel*

Record the sound of birds

There is only one thing that is more difficult than recognizing the sound of a bird: recording it. It isn't easy to filter out background noises. The technical requirements (equipment) might be very demanding (for example special microphone), therefore it is not advisable to "hunt" for these birds when they sing alone. The recordings must be long enough so that the audience could familiarize themselves with the melody and the tone to some extent, at least on the level of recognition. If the students make such a collection, there is a chance that in due course they will not only learn about the certain bird's build, behavior and lifestyle but will recognize its sound as well.

Recommended software:

For recording sounds: *Sound Recorder*

For playing the recorded sounds: *Windows Media Player*

Make diagrams of food chains

First the food chain should be composed – if it is not borrowed from a book – by research work and then it should be graphically displayed with the appropriate software. It must look perspicuous and the markings must be used consistently. It can be particularly difficult to arrange the items when drawing diagrams of food networks. There might be several correct solutions. If you project the diagrams on a screen, the process and all the connections within the food chain are easily explained. By deleting the name of one or another animal from the diagram you may produce a very interesting completion task.

Recommended software:

For creating presentations: *PowerPoint*

Write an essay about the life and work of a famous scientist

The topic of the essay can be: researchers, doctors, travelers. The most difficult, but also the safest way of collecting data is to do research in the library, because although there is a lot of data on the internet, they are often not vetted, therefore they are often imprecise and sometimes even false. Therefore an essay which solely uses sources on the internet is not necessarily the best one. Nevertheless, you can download very good quality diagrams and pictures from the internet. A good essay is precise, correct and a nice read, easy to understand

and perspicuous; it should look appealing to the reader so that he takes it in the hands and, if not reads it from cover to cover, at least flips it through. While making it, the student learns how to write an introduction, maybe an afterward too, how to edit an accurate bibliography and table of contents, to divide a text into chapters, to insert diagrams and pictures, to make a cover and to find appropriate ways of connection.

Recommended software:

For creating documents: *Word, Publisher*

Greenery

Make your students create pie diagrams that illustrate the percentage compound of the natural greenery in their country. Data can be obtained from statistics. The students may choose from several diagram types. As well as accuracy of data, expressiveness is also very important. After copying them into PowerPoint, you can analyze the diagrams together with the class. Slides might be animated, if you can set common categories.

For example forests: pine, oak, beech, etc.

Recommended software:

For creating presentations: *PowerPoint*

For creating spreadsheets: *Excel*

Make a plant morphology quiz with pictures

When the students have taken a great number of pictures of certain parts of plants – especially of the leaves and the flower, but the root, stem and the seeds are also good for this purpose – print or project these photos and write questions to go with them; the students can match their knowledge with their classmates on plant morphology. Make sure the particular parts of the plants are shown clearly in the pictures.

Recommended software:

For creating documents: *Word, Publisher*

For creating presentations: *PowerPoint*

Update your knowledge concerning human evolution

Recent research in this field has brought forth a large amount of different hypothesis and information, and to be familiar with these is essential in broadening your knowledge and forming opinions, therefore collecting the newest information is a most educational task for students. Apart from journals, their most important source should be the internet. The material collected by individual groups can be compared and discussed.

Make a short movie on a biological experiment

There are some experiments that cannot be carried out in classroom settings or within the duration of a lesson. You may make short movies that show the key moments of these experiments, so that the students can see all the stages of the processes in question. Such an experiment is the one that proves the existence of habituation, the simplest way of learning. After a while animals get used to the indifferent stimuli, and they won't react unnecessarily. This experiment can be performed with the escargot: the more we knock on the table, the less the escargot will contract its body in fear. In the movie it is enough to record the contractions, the students don't need to wait for the animal to relax.

Recommended software:

For editing photos and creating slideshows: *Photo Story 3*

<http://www.microsoft.com/downloads/details.aspx?FamilyID=92755126-a008-49b3-b3f4-6f33852af9e1&DisplayLang=en>

For creating movies from photos and videos: *Movie Maker 2*

(The Windows Movie Maker 2.1 is part of Windows XP Service Pack 2)

For creating presentations: *PowerPoint*

Design a label for the Biology exercise book

Apart from the wrapper on a textbook, a personalized label is what really reflects the personality and, of course, the creativity, of the owner! The label made by the students – if possible – should also hint at what material is covered by the class in the given subject in the given school year.

Recommended software:

For creating labels: *Word, Publisher*

The evolutionary development of the plants and animals

Make a diagram of the evolution of (some species of) animals, its development to our days, with the PowerPoint organization chart. You can make it more exciting with illustrations, maps, sounds, etc. from Encarta Encyclopedia.

Recommended software:

For creating presentations: *PowerPoint*

Smoking kills

Students read and listen to an article about how smoking kills at

<http://www.cdlponline.org/index.cfm?fuseaction=activity1&topicID=3&storyID=107>

They discuss the article and try to do a research on WebPages and in their environment to find out what harmful and other negative effects can smoking cause in the human body or in the society.

A few informative pages:

<http://www.archive.official-documents.co.uk/document/cm41/4177/contents.htm>

<http://library.thinkquest.org/17360/>

<http://news.bbc.co.uk/2/hi/health/3099936.stm>

They create a PowerPoint presentation or a webpage on their findings with the help of the teacher.

Recommended software:

For getting information: *Internet Explorer*

For creating presentations: *PowerPoint*

For creating a homepage: *FrontPage*

For creating documents: *Word, Publisher*

Literature

Compulsory Reading

The students have to make a presentation similar to movie trailers for the compulsory reading. The presentation can be recorded with a video camera, or it could also be a PowerPoint presentation with automatic timing and narration. The “trailers” should be presented in class!

Recommended software:

For creating presentations: *PowerPoint*

Home essay

More and more teachers encourage their students to hand in their essays in printed format, sometimes even via e-mail. If the teacher is given the essays in doc files, the costs of printing can be spared. Moreover, marking can be done in Word’s proofreading function (it is surprisingly multifunctional and useful) and the student could receive the marked essay in file, and could see his mistakes clearly at once. Many students upload their essays to the internet, and a lot of people use them. If proofread, categorized essays were put on the internet, or maybe on the homepage of the school, it would be beneficial for everybody.

Variation:

If the school creates an SPTS and a WSS then written assignments can be handed in and marked through this system, which makes it easy to assign competences, is very comfortable, controllable, perspicuous and uniform. It can easily be arranged, that students could view the

essays written by their fellow students, so that they can learn from each other's mistakes, or borrow ideas. (Office XP or 2003 is suitable for the task.)

Recommended software:

For writing essays: *Word*

Literary journey

Use moving arrows to mark the most important places in the life of a famous poet on the map! When the moving arrow reaches one of the marked settlements, a click should reveal a presentation with the following information: when did the poet go there, what did he do there? And pictures in connection with the poet's life in that particular place.

Recommended software:

For creating presentations: *PowerPoint*

The Uffizi art gallery

Take a virtual walk in the Uffizi art gallery in Florence! You will find plenty of pictures with a biblical subject. Choose 8 pictures and make a PowerPoint presentation! Beside the pictures there should be the exact source of the story (e.g. New Testament, Second Gospel according to Matthew), and the story itself in short! Under the pictures there must be an appropriate short quote from the Bible.

The English homepage of the Uffizi Art Gallery:

www.virtualuffizi.com/uffizi

Recommended software:

For creating presentations: *PowerPoint*

Comparing the Renaissance and the Baroque view

Download the pictures of the statues Pieta by Michelangelo and The vision of Saint Therese by Bernini from the internet! Put the two pictures next to each other so that between them there is enough space for speech bubbles. Make a web page. By clicking on a part (head, trunk, hand, leg) of the bodies of the women (Maria and Saint Therese), the typical features of the style should appear there in a bubble.

For example: Pieta (head) bending down pose, calm, but sad face, etc.

Recommended software:

For creating web pages: *FrontPage*

Literary quiz game

Devise a literary quiz game: recognizing quotations from the works of a famous poet! First the quote should appear, and then, ten seconds later, 3 options. The player can answer by clicking on one of the 3 options. A smiling or a crying face should indicate right or the wrong answers. The game should contain ten quotes, and in the end the total score of the player should be shown.

Recommended software:

For creating presentations: *PowerPoint*

Artistic presentation

Find a painting or a statue of the following characters from Greek Mythology, and then make a presentation or webpage, in which next to the pictures you put any story related to the character. Tell this story in the style of myths! The characters are: Kronos, Poseidon, Athena, Achilles, and Ulysses.

Recommended software:

For creating presentations: *PowerPoint*

The life of a famous poet

Make a presentation or a webpage about a famous poet with pictures, biographical data and quotes from poems. The quotes should not be written only, but when clicked on, they must be heard, perhaps with music.

Recommended software:

For creating presentations: *PowerPoint*

Motive research

Conduct a research about the ship and garden motives in literature and other arts! Make a table of the results of your research, in which include the following things:

- In which work (literary or other) does the motive appear? - author, exact title and the date of the making
- How do you interpret the meaning of the motive in that certain work of art, what is the motive's base content?
- A characteristic passage (quote or picture) from the work

The table must be arranged in chronological order!

Write footnotes to an ancient classic

Write footnotes to the first chapter of some aged literary work! Write explanations with illustrations to the words that you think are rarely used or obsolete. A finger must indicate these words, and when clicking on them, a bubble must appear with the explanation!

Recommended software:

For writing footnotes: *Word*

Photo story/Mini film/Blog

When students read graded readers, usually they only learn their vocabulary, discuss them, or sometimes write tests or compositions on them. It is a good idea to work with the story more than just doing the above activities.

- *Version 1:* Students choose the most important turning points of the story and using a digital camera they create the photo story of the book. They might want to use costumes, scenery, to make the story livelier. They can play the roles of the characters in the story and personalize such things as animals, plants, etc.

When they are finished, they put the pictures together in PowerPoint and present it to the whole class. (If they work in different groups, they may come up with different ideas, different stories.)

- *Version 2:* Students write a screenplay from the book and decide on the different roles – the director, the cameraman, the assistant and the cast.

With the help of the teacher they shoot the scenes of the screenplay and put the whole film together, based on the book.

When they are finished with the film, they might want to organize a school film afternoon or festival where they can show their films.

- *Version 3:* Before students read the book, they choose a character. As they read the book, they take the role of their own character and keep a blog about what happened to them, what they think and what their feelings are.

When everyone has read the book, the class looks at the blogs, reads them and discusses how they are different from the original story.

Blog sites: <http://www.blogger.com/start>, <http://www.blogwise.com/>

Recommended software:

For editing photos: *Microsoft Office Picture Manager*

For creating movies from photos and videos: *Movie Maker 2*

(The Windows Movie Maker 2.1 is part of Windows XP Service Pack 2)

For creating presentations: *PowerPoint*

For creating documents: *Word*

Language

Genres of journalism

Find examples of news, report, interview and criticism in recent weeks' printed press on the internet. Download these articles and mark their sources clearly. Make a short analysis to every text, in which you describe the features of that certain genre with examples from the chosen text. Solve the task in such a form that the analysis is typographically separated from the original text.

Recommended software:

For creating documents: *Word*

Daily Paper

Imagine that you are the editor of a daily paper! Your task is to plan the main page of one of your issues - the front page! Give a title to your newspaper! Design the heading and note what other information must be included on this page. Decide what fonts should be used and what kind of articles should be on the page! Mark the place of the pictures, too! Finally, make the page according to the plan you have created!

Recommended software:

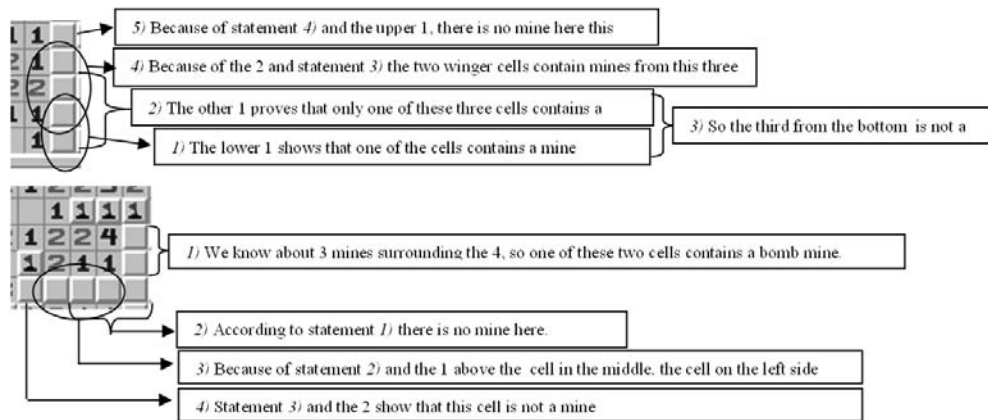
For creating publications: *Publisher*

Mathematics

Minesweeper for improving mathematical abilities

Almost everyone knows the game called Minesweeper, but only a few know exactly the facilities of this game. Beginners usually try to establish the status of a cell by guessing from the numbers in the surrounding cells, which is hardly a successful strategy. For an enjoyable game the player needs to draw the conclusion from more information.

Note the statements and the conclusions in the following two graphs:



The one who finds more clues will be the faster player. When phrasing the clues we can clarify the concept of necessary and sufficient conditions. A large amount of exercises can be composed based on the game. It is nice to play Minesweeper on the first day after a longer holiday, on the last day before a holiday, in the 100th class, or a screenshot may even be included in a test.

Graphic solutions of problems in spreadsheets (e.g. oncoming vehicles)

A sample problem: A dog sees a rabbit 80 m far away, and starts to chase it. The two animals start to run at the same time, in the same direction. The rabbit jumps 10 times a second, while the dog jumps 9 times a second. The rabbit jumps 80 cm, the dog jumps 1 meter long. How much time does it take for the dog to catch the rabbit?

Represent your solution on a spreadsheet, with a distance/time diagram. Try to find a general solution. How do the original distance, the jumps per second, and the length of the jumps change the outcome? Write down the solution using parameters for distance and jumps per second. Plot the values on a diagram.

Recommended software:

For creating spreadsheets: *Excel*

“Construction” with a drawing tool

Office contains a built-in drawing tool, which can be used in **Word**, in **PowerPoint**, and in **Excel** as well. This tool is vector graphic, so individual elements can be transformed as learnt before: reflection, translation, central reflection, reflection and similarity transformation, perpendicular affinity. When drawing the shapes, you take advantage of their regularity or their central symmetry. Having learnt all this, students may complete simple construction tasks on the computer to use their knowledge in practice.

Sample tasks:

- Draw road signs. (e.g. Dead-end sign, STOP sign, No entry sign)
- Draw the altitudes of a triangle. Make it so accurate that the lines would meet in one point, even if it is magnified to 200%.

Function-transformation with animation

Plot the previously learnt function in a point (XY) graph. Solve the function parametrically (e.g. $y = a(x-u)^2 + v$), using about 20 reference points; the parameters should be in referenced cells. Fix the scale of the Y axis, and watch carefully how the looks of the diagram change when the parameters are modified. For easy modification of the parameters, insert a scrollbar from the **Forms** toolbar.

Recommended software:

For creating spreadsheets and diagrams: *Excel*

Simplifying algebraic equations - Microsoft Equation

Simplify an algebraic equation step by step. Write down, which rule was used in each step. Always copy the previous equation and then modify it as needed. (This helps you to understand the logic of mathematics. In addition, copying mistakes and typos are eliminated.)

An example:

$$\frac{ax + ay}{x^2 - 2xy + y^2} \cdot \frac{2x - 2y}{ax^2 + 2axy + ay^2}$$

Studying trigonometric functions on computer

In the following spreadsheet trigonometric functions can be studied. Fill in the degree column with values that make up a complete circle. (0°-360°)

- Calculate the values using formulas, but only using **SIN()** and **COS()** functions. Don't use the built-in functions for transforming degrees to radian.

- Create two point diagrams using the **degree, tan, cot** values. On the first diagram use two-pt wide markers to plot the function. In the second one, don't use markers, but connect the points with lines. In both diagrams the maximum and minimum values of axis y should be 10 and -10 respectively, the maximum of axis x should be 360° , and no gridlines should be used.
- Expand the spreadsheet with a new column which contains the values of $\sin^3x + \cos^3x$. Create a diagram for this column as well.

<i>Degree</i>	<i>Radian</i>	<i>Sin</i>	<i>Cos</i>	<i>Tg</i>	<i>Ctg</i>
0	0,000000	0,000000	1,000000	0,000000	
1	0,017453	0,017452	0,999848	0,017455	57,28996163
2	0,034907	0,034899	0,999391	0,034921	28,63625328
3	0,052360	0,052336	0,998630	0,052408	19,08113669
4	0,069813	0,069756	0,997564	0,069927	14,30066626
5	0,087266	0,087156	0,996195	0,087489	11,4300523
⋮	⋮	⋮	⋮	⋮	⋮

Recommended software:

For creating spreadsheets: *Excel*

Proving Geometrical Propositions in presentation

Create a presentation to demonstrate a geometrical proposition. Make sure you start with the proposition and move along towards the deduction. The presentation should consist almost entirely of mathematical symbols, and only a minimal amount of text, somewhat like a silent film. (If the task is not solved properly, it either shows that the student does not know how to 'prove' a proposition, or it can be easily established which part the student is having difficulties with.)

Recommended software:

For creating presentations: *PowerPoint*

Budget for the school snack bar

Create a budget for the snack bar at a school ball. The bread, cold meat, cheese, and cucumber are sold in packages which contain more than the quantities required for one sandwich. (e.g. one pack of bread contains 25 slices, the cheese pack contains 10 slices). Create a spreadsheet that calculates the ingredients needed for e.g. 500 sandwiches. There should be cheese sandwiches, cold meat sandwiches, and sandwiches which contain cheese and cold meat as well. Try to minimize the leftovers.

Suggest a price for the sandwiches.

(Use diagrams or solver programs to find the best possible solution.)

Using formulas in general (calculating data of right triangles)

Create a sheet in **Excel** to calculate the parameters of right triangles. The parameters are: the length of the three sides, and two angles (not the 90 degrees). The spreadsheet should calculate any three of these given the other two. In each formula refer only to the given values. (The task consists of five parts, provided that you don't differentiate between the two legs: two legs, one leg and the hypotenuse, a leg and the angle connected to it, a leg and the angle opposite to it, the hypotenuse and an angle connected to it)

A more general solution can be given using the sine and cosine laws.

Recommended software:

For creating spreadsheets: *Excel*

Probability – Analyzing average, dispersion and distribution using the RAND() formula

In a medieval gambling game the player rolled four dices. His bet was doubled, if the sum of the four dices was less than 9 or greater than 19. If the sum was between 9 and 19, he lost his bet. Create an **Excel** spreadsheet using the random number function. Simulate a hundred bets. Observe the outcome. What are the chances of winning? Make calculations, and create diagrams to represent the number of occurrences of the potential sums.

Recommended software:

For creating spreadsheets and diagrams: *Excel*

Analyzing complete induction – comparing recursive and explicit formulas

Calculate the sum of the first n natural numbers, using the recursive formula (always add the next number to the sum)

$$S_n = S_{n-1} + n$$

Calculate the numbers using the learnt explicit formula as well.

$$S_n = \frac{n(n+1)}{2}$$

Transforming functions

Using function plotter a function and its transformed functions can be plotted in one diagram.

Experiences: The four kinds of transformation can be easily visualized.

Prime numbers

Play this game in groups of 2 or 3. Which group can find a larger prime number than the others? Make a competition with 3 types of groups.

- On paper, using a calculator (Filter method dedicated to Aristotle)
- Write a program, which calculates prime numbers (using your favorite programming language)
- Look for a page on the Internet which contains a list of prime numbers. (save the url)

Finally, compare the results. Why are the individual methods slow/fast? How reliable are the results?

Plotting formulas

Use the automatic fill function and copy formulas to create source data for diagrams and create diagrams with the diagram wizard for easier analysis of various functions.

Experiences:

- The students enjoyed it very much.
- This technique makes plotting and analysis of functions quicker, and easier to understand.

Recommended software:

For creating spreadsheets and diagrams: *Excel*

Installments

Use the **PMT()** formula to calculate the monthly installments of a loan for a given amount of money (e.g. 1 €), where the rate and the term change. In what case is the short or the long term better for you?

Experience: Easy, spectacular, surprising.

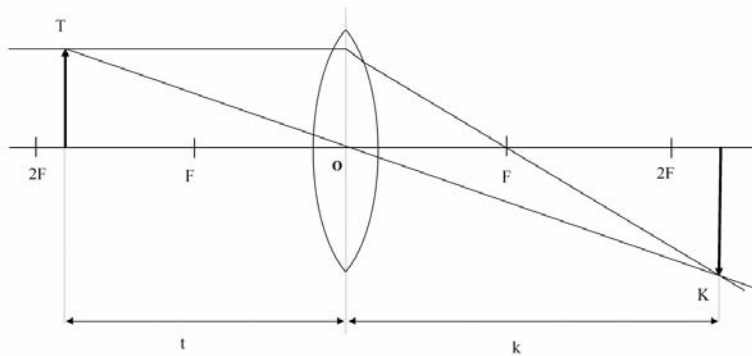
Suggested homework or test question: Try to do similar calculations concerning retirement savings.

Variation/Follow-up: It is worth considering the problem of pensions.

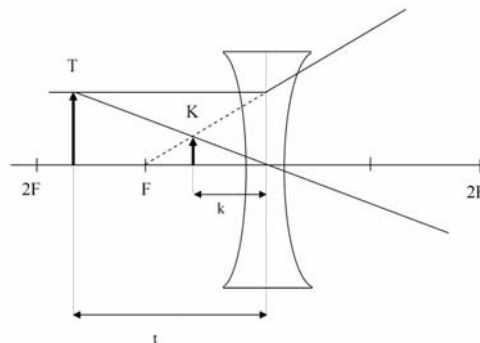
Physics

Presentation of the convex lens

Create a slideshow presenting the image a convex lens produces when the distance of the object from the lens is more than the focal length but less than double the focal length. The slideshow should contain the following slides:



- a) The first slide should be a title slide. The title is “Image formation by the convex lens”, and the subtitle is “if the distance of the object is between the focal length and double focal length”.
- b) The second slide should contain a diagram showing the principal axis, the focal points (F), the double focal distance (2F), the convex lens, the object and the distance of the object. The title of the slide should be “The Convex Lens”.
- c) The title of the third slide should be “Image formation by the convex lens”. Put the same diagram on this slide. Then have the light rays - the ones that travel parallel to the principal axis and those that pass through the vertex (O) - then the image (K) and the distance of the image (k) slide in from the left with an animation.
- d) Based on the illustration on the next page, make a presentation on how a concave lens forms an image.



Recommended software:

For creating presentations: *PowerPoint*

Refraction of light on a lens and reflection from a mirror

Make a slideshow on the laws of refraction. Show where the image is formed if the object is beyond $2F$, within $2F$, between F and $2F$, at the focal point or within the focal length. Take advantage of the fact that some parts of the diagrams remain unchanged, so you can create your slides by copying and modifying.

(Note: You can easily demonstrate how the refraction laws work by changing the location of the object and the path of the light rays.)

Recommended software:

For creating presentations: *PowerPoint*

A distance-time problem

A cyclist sets off to look for his friend. Starting from a stationary position he moves with constant acceleration (a) for t_1 time, then he continues moving with a constant velocity for a t_2 time before he starts to brake. The degree of deceleration is double the acceleration. Calculate the velocity and the distance traveled every consecutive second in an Excel spreadsheet, and then prepare a velocity/time and a distance/time diagram to illustrate the kinematical aspect of the motion.

($t_1 = 8$ s; $t_2 = 60$ s; $a = 1$ m/s²)

The actual way of solving the problem depends on the age and the extent of computer knowledge of the class.

Generalize the problem: Make the rate of acceleration variable. Calculate the velocity with the help of the **If()** function, so that you can allocate the duration of acceleration, constant velocity, and deceleration as parameters. In the case of deceleration, you need to be careful so that the object doesn't start moving backwards.

Recommended software:

For creating presentations: *PowerPoint*

The evaluation of the results of measurements (e.g. measuring gravitational acceleration with a dropping machine)

Perform several series of experiments with a dropping machine (e.g. measure the total time it takes for 10 balls to drop 5 times) Collect the data in a table which includes the dropping height. Calculate the time it takes for a ball to fall down and the gravitational acceleration according to the data. Define the average and scatter.

Recommended software:

For creating spreadsheets: *Excel*

Demonstrating constant acceleration approximating with constant motion

An underground railway train accelerates to 20 m/s in 1 minute. Calculate the velocity of the train at the beginning of every consecutive second. Instead of constant acceleration, analyze the motion as if the train was moving at a constant speed for the duration of each second. Calculate the distance covered in each second this way, and the distance from the starting point at the end of each second. Plot the distance traveled against the time passed on a diagram.

Adjust the approximation of distance traveled by making the intervals of time smaller. Define the function of time against distance when acceleration is constant. By calculating the values test the results of the approximation with the results of the function, and compare how close the two are to each other.

Recommended software:

For creating spreadsheets and diagrams: *Excel*

The dynamics of the motion of waves

When examining wave motion from the point of view of one single particle, the motion is caused by the neighboring particles exerting force toward themselves, while the particle would like to continue its motion in the original direction. Keeping the above said in mind, model the motion of waves.

Make a model of as many different phases of the wave as possible (at least 1000). In the beginning make every particle's displacement zero (equilibrium position), except for the two in the middle, whose displacement is non-zero. For the next phase (and each subsequent one), each particle can be described by its own previous displacement and its distance from its neighbors. Define a function to describe this relationship and use it to calculate the rest of the phases. Create a diagram of some of the phases and of the state of some of the particles to see how well the function reflects actual wave motion.

Recommended software:

For creating spreadsheets and diagrams: *Excel*

Lissajouse patterns

Calculate the sine and cosine of every 5 degrees, and plot the results on a line diagram so that the horizontal axis is the cosine and the vertical axis is the sine (you should get an image of a circle). Modify the functions so that the arguments are their own multiples (e.g. $\cos 2$, $\sin 3$). See how the image changes for different values. Explain why the image becomes distorted when the values become very large.

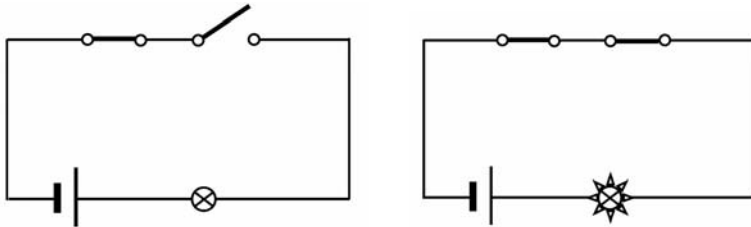
Recommended software:

For creating spreadsheets and diagrams: *Excel*

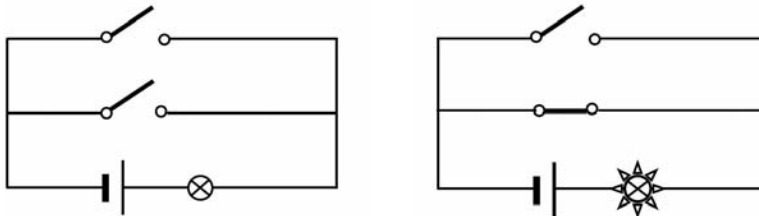
The demonstration of circuit diagrams

Make a presentation based on the attached images to illustrate switches connected in a series, in parallel and in alternation.

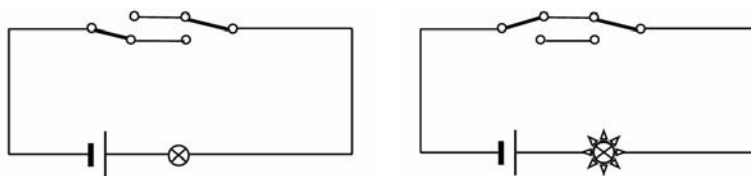
- Make the first slide a title slide, with the title “Connecting switches”, and make your own name the subtitle.
- On the second slide put an image similar to the one on the left beneath. Make the switch on the right close itself so that it completes the circuit and make the lamp light up with an animation. Make the tile of the slide “Series connections”.



- The third slide should contain an image like the one on the left beneath. As with the previous slide, transform the image so that the lower switch completes the circuit and the light goes on with an animation. Make the title “Parallel connections”.



- On the fourth slide include an image as the one on the left beneath. Transform the image as previously (circuit is completed, light goes on) with an animation. Make the tile of the slide “Alternate connections”.



Recommended software:

For creating vector graphic circuit diagrams and presentations: *PowerPoint*

Analyzing combination circuits

A long corridor is lighted by two rows of lights (each row containing 5 lights). There is a light switch for both rows on both sides of the corridor.

This is a difficult problem, because we don't always know where the wires that come out of the wall start out from. Examine what happens if the wires are swapped (which lights light up in certain positions of the switches). Collect the data in an Excel table and deduct the rules that can be established on the basis of the table.

Give your peer a task: present him with the result (the position of the switches and the state of the lights) of a connection that is messed up and ask him where the mistake is.

Sample:

State of the switches				Observation		Goal	
1A	1B	2B	2A	Light A	Light B	Light A	Light B
↑	↑	↑	↑	⊙	○	⊙	⊙
↓	↑	↑	↑	⊙	⊙	○	⊙
↓	↓	↑	↑	○	⊙	○	○
↑	↓	↑	↑	○	○	⊙	○
↑	↑	↓	↑	⊙	○	⊙	○
↓	↑	↓	↑	⊙	○	○	○
↓	↓	↓	↑	○	⊙	○	⊙
↑	↓	↓	↑	○	⊙	⊙	⊙
↑	↑	↓	↓	⊙	○	○	○
↓	↑	↓	↓	○	○	⊙	○
↓	↓	↓	↓	○	⊙	⊙	⊙
↑	↓	↓	↓	⊙	⊙	○	⊙
↑	↑	↑	↓	⊙	○	○	⊙
↓	↑	↑	↓	○	⊙	⊙	⊙
↓	↓	↑	↓	○	⊙	⊙	○
↑	↓	↑	↓	⊙	○	○	○

Recommended software:

For creating circuit diagrams: *Paint*

For creating vector graphic circuit diagrams: *Word or PowerPoint*

For creating spreadsheets: *Excel*

Creating the schematic diagram of a real circuit (the strings always take a different path)

The light of a microwave oven is on if the machine is operation or if its door is open. Create the diagram of the lighting scheme, representing the start button and the door with the symbols of switches.

Recommended software:

For creating circuit diagrams: *Paint*

For creating vector graphic circuit diagrams: *Word or PowerPoint*

A drink – The generic solution to a problem in thermodynamics

Drinks are to be served at 5°C. They are, however, often at a different temperature when served, so some -10°C ice needs to be added. Make a table into which you can enter the specific heat, the mass and the temperature of the drink, and which calculates the amount of ice which needs to be added to achieve a temperature of 5°C. Take an ice-cube holder, and estimate the size of an ice cube. Put a function in the table which, based on the amount of ice in a cube and the quantity required, tells you how many ice cubes you need.

Recommended software:

For creating spreadsheets: *Excel*

Measuring the temperature of water in different vessels, covered or uncovered, and on different kinds of heaters

Measure the temperature of the same amount of water in the same kind of vessel on different types of heaters every consecutive minute until the boiling point is reached. Complete the same measurement with the vessels covered. Plot the results on a diagram and analyze the curves. Find out the performance of the heaters, and calculate their efficiency.

Recommended software:

For creating spreadsheets: *Excel*

Learning about radioactivity

The beneficial effects of using radioactive isotopes in medicine should be emphasized. This is why the following topics are suggested.

- The role of isotopic tracers in biology
- The role of isotopic tracers in condensed matter and material science

To utilize the possibilities of the web in an organized way, try the following

- In the case of a class of 30, make 6 teams
- Every team should name a spokesperson who presents the topic
- The presentations should be held before the entire class
- Each team should create a presentation of at least 10 slides from the allotted topics
- The presentations should include quiz questions, a crossword puzzle, pictures, and a bibliography
- The audience (the class) should rate their classmate's work

The presentations should be put on the school's server, so that everyone has access to them.

A useful webpage:

<http://www.safety.ubc.ca/rad/calc/calcfame.htm>

Teaching radioactive decay series

Students have trouble telling the difference between radioactive decay series. It is quite difficult for them to understand the different notions. It helps, therefore, to show the animations and simulations available on the net when teaching this topic.

Useful website:

http://eundp.digitalbrain.com/bjaro.eundp/web/Bomlasi_sorok/linkek/?backto&verb

The interactive simulation can be done in smaller groups as described, and then discussed. If you have the time, you can arrange a discussion, or utilize other cooperative methods to work on the topic.

- When teaching this subject, make sure you note the following interesting facts:
- Because of the balance in the decay series, it is possible to assess the half-life by measuring the concentration of individual members. (This answers the question "How do they know that uranium has a half-life of 4.5 billion years?")
- Explain why there are naturally occurring radioactive elements on earth whose half-life is a lot less than Earth's age.
- Note the phenomenon of natural radioactivity, and the fact that most of the radiation that surrounds us comes from naturally occurring elements in Earth.

The curriculum includes a number of concepts relating to radioactivity (activity, half-life, etc), so it provides you an opportunity to cover some of the topics in class, and the students have a chance to do some individual study as well.

In order to make the concepts more interesting, try showing the following animations in class:

<http://physics.uwstout.edu/physapplets/a-city/physengl/decseries.htm>

Teaching resonance (forced vibration)

Note to the students that there are numerous examples of forces acting periodically on systems in our everyday life.

An example: Getting a car out of a pothole

In this situation, the car is rocked back and forth, and ideally at the right time, the driver presses the gas pedal to help. If the frequency of the pushes is the same as the car's fundamental frequency, the extent of the swings become larger and larger, and the car is thus easier to get out of the pothole. The force creating the vibration is the "induction force", and the process is called induction.

The Tacoma Bridge, in the USA, was blown by winds whose gusts had, unfortunately, the same frequency as the bridge's fundamental frequency. This is why the amplitude of the rocking, which was quite small to start with, gradually increased, until the bridge fell down. This is why soldiers marching across a bridge are forbidden to step simultaneously, otherwise the force their feet acts with upon the bridge might resonate it. If you show the students what happened to the Tacoma Bridge, they will see an astonishing example of resonance which is impossible to recreate in a classroom. You can download the movie here (in mpeg format):

<http://www.enm.bris.ac.uk/research/nonlinear/tacoma/tacoma.html>

<http://www.enm.bris.ac.uk/research/nonlinear/tacoma/tacnarr.mpg>

There is an interactive simulation of forced vibration on the following website. Before viewing the simulation, divide the class into three groups. Each group should receive a different task. As a summary, after viewing the simulation, each group chooses a spokesperson, who describes the results, after which everyone participates in a discussion on what they saw in the following diagrams:

- The elongations of exciter and resonator as functions of time
- The amplitude of the resonator's oscillation dependent on the exciter's angular frequency
- The phase difference between the oscillations of exciter and resonator dependent on the exciter's angular frequency

<http://www.walter-fendt.de/ph14e/resonance.htm>

Teaching motion with a constant acceleration

This topic provides the perfect opportunity to show how theoretical knowledge can be applied in real life. One cannot start preparing the students for everyday commuting and preventing accidents too soon.

The driver's reaction time plays a considerable role in preventing traffic accidents. If the driver can react in time to an anticipated event and hits the brakes in time, then the accident is most probably avoided, or at least its seriousness is reduced.

When measuring and determining reaction time we can apply the laws of physics in practice.

To understand the significance of reaction time, I suggest that each student does the following simulation individually:

<http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=224> (*Reaction Time Measurements*)

With the help of the simulation the students can measure their own reaction time, and estimate certain values. For example, they can evaluate how long (if the break distance is given) and how much time it would take them to stop on a highway if something unexpected occurred.

Note that the break distance is dependent on the quality of the ground. In the winter, for example, the coefficient of friction is much less between the wheel of a car and the icy road.

You can change the velocity and the coefficient of friction in the simulation. Changing the parameters alters the break distance, which is also dependent on the coefficient of friction. The simulation is a perfect example of theoretical knowledge put into practical use. It becomes clear that what is learned is consistent with everyday life.

The students can measure their reaction time with the next simulation, only there are 10 cars on the highway now. They can note how to avoid the accident in case the first one collides.

This simulation is a good model of what happens all too often in real life.

<http://www.phy.ntnu.edu.tw/~hwang/> (*Reaction time and car accident*)

More exactly: <http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=225>

Suggested links in this topic:

<http://www.schulphysik.de/>

To run the simulation you need Java 1.4.

Teaching the swinging pendulum

When teaching the pendulum, don't leave out the easy-to-do, basic demonstration. (Put a small ball on the bottom of a long string, and push the ball a little so that it doesn't go too far from its equilibrium.)

From this experiment, the students can draw the following conclusion: the body moves constantly around its starting point in both directions. In the form of a discussion, the following can also be established about the body's motion:

After equal periods of time, the motion repeats itself

- The motion is always symmetrical to a certain point

•

Doing the experiment isn't enough for the students to see how the deflection, speed, linear acceleration, force, and energy depend on the time in the case of the pendulum. For the sake of illustration, try showing the following simulation:

<http://www.walter-fendt.de/ph14e/pendulum.htm>

To run the simulation you need Java 1.4.

The following simulation is interactive; the students can determine the length of the string.

<http://www.phy.ntnu.edu.tw/~hwang/> (Pendulum)

<http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=27>

Other links:

<http://www.avmz.uni-siegen.de/~volker/projects/Pf1/W3-short/samples.html>

<http://www.df.uba.ar/~dgomez/mec/links.html>

Teaching Brownian motion

This topic calls for the project method. Use two 45 minute lessons to complete the project. By applying the method, the students can experience the joy of seeking and finding, as well as that of discovery, while getting involved in the topic. Split up the class into three groups.

Group “A” (within which each member receives an individual task) should work on the following in the IT room:

- Gather information on the botanist Robert Brown (1773-1858), and create a short Power Point presentation, which they will present during the second lesson.

Source: <http://www.brianjford.com/wbbrowna.htm>

- Analyze the simulation on Brownian motion at the following website:

<http://www.phy.ntnu.edu.tw/~hwang/>

<http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=41>

<http://intro.chem.okstate.edu/1314F00/Laboratory/GLP.htm>

- During the second lesson, one student should demonstrate the simulation, by downloading the free version and analyzing it.

<http://www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=42>

Group “B” should do the following experiment, note what happened, discuss the conclusions, and create a presentation.

The experiment:

E1: Put a sugar cube into hot tea, without stirring it. Watch what happens.

E2: Put some Potassium permanganate in the bottom of a clear vessel, and carefully pour some water on it. Watch what happens.

Group “C” should do the following experiment, note what happened, discuss the conclusions, and create a presentation.

The experiment:

E1: Put a droplet of milk on the slide of a microscope, and see what it looks like with a magnification of 1000. After some time, blow warm air from a hair-dryer in the general direction of the slide.

E2: Drop some crystal iodine or one drop of brome in a flask, seal the flask, and see what happens.

After completing the tasks during the second lesson, the spokespeople of the groups should:

- Show the presentation about Robert Brown
- Show the simulation
- Explain the results of the experiments and present their conclusions.

At the end of the lesson the teacher should summarize the most important aspects of the topic.

The product of the project method is that the presentations, downloaded programs, and simulations should be made publicly available on the intranet in the school. The students have had an active part in discovering and learning the subject, and so the project method is a success.

Recommended software:

For creating presentations: *PowerPoint*

Teaching the practical uses of chain reactions

While covering this topic, it is our task to assume the role of the environmental educator and provide the students with information on nuclear energy.

The awareness of the students is important from many different points of view, since they represent the generation of the future, who will have a choice to put their vote down with responsibility for or against nuclear energy.

(According to research, students get very little information about nuclear power plants in physics class. In many cases teachers simply leave out atomic physics altogether because of lack of time. Because this topic isn't covered, the students never hear about nuclear power plants in school.)



The secure operation of a nuclear power plant is complex from an environmental point of view. Students usually believe that those power plants which are the least harmful to the environment are the most secure.

The students' attitude towards nuclear power depends greatly on whether they like physics, so I think it is very important that they get a clear picture on the issue.

Try the following simulation:

<http://www.ida.liu.se/~her/npp/demo.html>



Newton's gravitational laws, and planetary motion

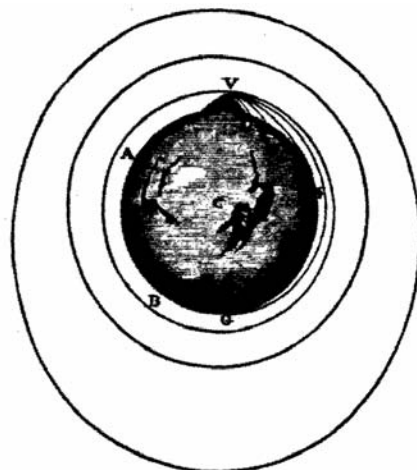
This famous picture from Newton's book shows that the same laws are applicable to the objects on Earth as to the heavenly bodies. The faster we throw an object from a high mountain horizontally, the farther it will fly. Provided the initial velocity is large enough, the curvature of the object's path follows the curvature of the Earth's surface, and the object returns to the initial starting point. If we duck, the "rock" will fly over us and will continue to go round and round the Earth. (If we ignore the effects of drag,) we can put satellites in Earth's orbit with this method. Should the initial velocity exceed a certain limit, the object escapes from the Earth's gravitation and does not return. You could draw this picture on the board, but it is a lot more exciting if the children experiment with different initial velocities and draw the conclusions on their own. The animation on the following web site can help:

http://galileo.phys.virginia.edu/classes/109N/more_stuff/Applets/newt/newtmtn.html

The initial speed of the "rock" can be set here. This program draws the path of motion. The launch and the impact are accompanied by sound effects. It's instructive and entertaining.

Exercises:

The students can determine the escape speed and the orbital speed with the trial-and-error method. They will surely realize that a speed less than the orbital speed can be "successful"; the object will go around the Earth following an elliptical path, as in the case of a speed between the first and second cosmic speed. Find the focus-points of the ellipse. What determines the speed of orbit?



History

Calling cards for great people in history

Design a calling card for a great person in history! Find modern calling cards on the internet, then choose an interesting historical person and try to create a similar calling card with his data, rank and job!

Recommended software:

For creating documents: *Word, Publisher*

Making a gazette-like historical newspaper

Eyewitness

History in the style of a daily paper

Edit, make the lay-out for and print your own historical newspaper using news from the old times. The newspaper should be similar to the Eyewitness newspaper. Each issue should concern one particular period in history and should contain domestic, international or mixed news. Use Microsoft Publisher in your school!

Our example for the contents of an 8-page issue:

- 1 front-page with short news and preview from the contents
- 1 page on home news and foreign affairs
- 1 page on economy
- 1 page on science
- 1 page on culture with top list and bestseller list
- 1 page exclusive interview with a great person from that age
- 1 page of colorful, short stuff: public interest, sport, classified ads, weather forecast
- 1 last page: short news, preview from the next issue

The length, the headings and the subjects in the example are free to change. The articles can be illustrated, but don't make the page overcrowded with frames. The pages should be A4 size and fonts should be 10 points, Times New Roman. Apart from the headline, each article may contain one subheading if it is necessary. The articles will be separated from each other with a fine line.

Recommended software:

For creating newspapers: *Publisher*

Foreign Language

Biographies

To learn about famous people's lives and describing a person's life, to practice question forms.

The teacher prepares a short quiz on a celebrity's life. The level of the language and the difficulty of the quiz can be tailored to the students' level and age.

The students do the quiz by searching for information on the Internet. The following pages contain lots of biographies of famous people (from historical personalities to present day celebrities).

<http://www.biography.com/>

<http://www.infoplease.com/people.html>

When they are ready with the quiz, the whole class checks the answers.

The next step is to get into groups, choose a person they want to find out more about (the teacher might want to give the students some names to choose from to make the activity a bit faster and more controlled). They search the web for information on that person and create a quiz on him or her. Finally, they print the quizzes, swap and try to solve them. The quizzes can rotate in the classroom and students may vote on the most interesting or the best ones.

Recommended software:

For getting information: *Internet Explorer*

For creating documents: *Word*

Vocabulaire de la cuisine

Teamwork: students search for recipes for typical French dishes on the internet in groups of 2-4. From these recipes they should compile a full meal. One person from every team stands up and names the ingredients of a dish (one course per person), then he/she explains and mimes how to prepare the food. At the end the others have to guess what dish their classmate has made. The team that had the largest number of correct guess is the winner.

Suggested homework or follow-up task:

The students should write down a recipe for a dish which they can prepare on their own (it might as well be a simple sandwich).

Further variations:

Role-play in the next lesson: the students are in a restaurant and all their homework dishes are on the menu card but all with fictional names. The guests don't know the dishes so the waiter has to explain what they are, etc...

Les curiosités de Paris

Students look up sights and attractions of Paris (in French) on the internet, and note down important/interesting facts. They should download subject-related pictures, texts. In the second half of the lesson students report back to the class.

Everybody explains how they conducted their search (What was the keyword?) and what their findings were. Students share the more interesting websites with each other.

Suggested homework or assessment task:

For the next lesson everybody creates a summarizing document in Word using the pictures and information which were downloaded during the lesson, and their own notes. For assessment you can make a quiz with pictures and facts which were discussed during the lesson and on the next lesson the students are to complete the quiz on their own.

Further possibilities:

To follow up the task, students could search for information and pictures about their hometown, and translate the downloaded text into French. For the translation the use of mono- and bilingual internet dictionaries is allowed.

Plastic surgery

For practicing the vocabulary of appearance and picture description.

Students look for pictures of celebrities, famous people on the Internet, or use their own digital photos for the activity. They save one copy of the original photos (if they want to do the activity offline, they can print them as well).

• **Version 1**

In Paint they make changes on the photos so they are hard to recognize (e.g. make the nose longer, add glasses and a moustache, etc.).

In pairs, they show their picture to their partner who tries to find out who the person is. When they have made a good guess, they look at the original picture as well as the changed one, and list the differences between them.

• **Version 2**

In pairs, students change the pictures in Paint as described above but do not show them to each other. One student describes it to their partner who makes guesses about who is in the photo. If they don't find it out in a set time (e.g. 3 minutes), they change roles and repeat the activity. The student who can find out who the person is wins.

If neither of them guesses right, they look at the pictures and compare them to the original ones.

• **Version 3**

Students work in pairs and use the same pictures. One changes the photo in Paint and gives instructions to the other student what changes they should make in the photo. The other student follows the instructions (they can ask questions). At the end they compare the two pictures and discuss if they are very similar or very different from each other.

• **Version 4**

Students can find lots of photos at <http://www.doctorwarp.com/> where they can also change them and print them or send them to each other by email.

Recommended software:

For getting photos: *Internet Explorer*

For editing photos: *Microsoft Paint*

My hypermarket

Students look at websites of hypermarkets. They make a list of what they sell, what departments they have, etc.

They get into groups and design their own hypermarkets. They use Paint or the drawing function of Word to make the floor plans of the hypermarket. They make an advertisement leaflet or homepage as well.

When they are finished, they plan a live advertisement for their hypermarket and perform it in front of the whole class while showing their floor plans and leaflet/homepage.

Recommended software:

For getting information: *Internet Explorer*

For creating documents: *Word, Publisher*

For creating homepage: *FrontPage*

Whose horoscope is it?

To learn adjectives

Students visit WebPages and look up their own horoscope.

<http://horoscopes.astrology.com/>

<http://www.horoscope.com/>

They make two lists of adjectives: positive and negative ones. If they don't know a word, they can look them up in dictionaries or ask their teacher.

• **Version 1**

When they are finished with the lists, they go through them and pick the adjectives that they think really fit them. They write their names and these adjectives on small cards and give them to the teacher.

The teacher shuffles the cards and reads the adjectives on the first card. The students make guesses which classmate the adjectives describe. The first student who guesses correctly, may read the next card, etc.

• Version 2

Students write the adjectives they think fit them on a card, but do not write their names on it. Next, they start rotating the cards in the class and read the adjectives. They make guesses who the person might be and write the name on the back of the card, then pass it to the next student. When the cards have been seen by all the students, they look at each card and discuss if the guesses were correct.

• Version 3

Students write the adjectives they think fit them on a card, but do not write their names on it.

Each student gets a card, reads the adjectives, goes around the classroom and tries to find the person who the card belongs to by asking the other students some questions. When a student finds the owner of their card, they sit down (but they can be still asked by standing students!). The game finishes when everyone is sitting.

Recommended software:

For getting information: *Internet Explorer*

For creating documents: *Word, (it might be a good idea to use the Word processor and a printer for the cards so that students don't recognize each other's handwriting)*

Holiday time

To learn about holiday traditions, to raise intercultural awareness.

Students make interviews with their families and relatives to find out what traditions they have in connection with a certain holiday (e.g. birthdays, Christmas, Easter, etc.). They take their findings to the class and in smaller groups they share their findings. Then they try to collect the commonest traditions from which they make a list and describe their own nation's "typical" holiday traditions in a short composition or presentation.

Next, they choose a country of the target language and/or other countries and look up in books, on websites, etc. what traditions people have in these countries. Using the information they have found, in groups they create an interesting quiz to compare the different cultures and different traditions. Every group then solves the quizzes created by the other groups.

A good website to start the search from:

<http://www.holidays.net/>

Recommended software:

For getting information: *Internet Explorer*

For creating documents: *Word*

Local festival

Students look at websites of local festivals to get ideas of bigger events.

<http://www.festivalcity.hu/english>

<http://www.roskilde-festival.dk/>

<http://www.eif.co.uk/>

With the help of the teacher they make a brainstorming activity about what organization work a festival needs, choose a topic for a local festival (it can even be a school festival!) and choose a role for themselves.

They discuss the whole festival and create posters, leaflets, a radio and a TV advertisement to advertise the programmes.

Eventually, they may organize the whole festival for the whole school.

Recommended software:

For getting information: *Internet Explorer*

For creating documents: *Word*

For creating presentations: *PowerPoint*

For creating movies from photos and videos: *Movie Maker 2*

(The Windows Movie Maker 2.1 is part of Windows XP Service Pack 2)

Chemistry

Food additives

We are told more and more about the additives that are used in the making of our food. Why don't you ask your students for a piece of chocolate or a refreshing drink in class and then check together on the internet what exactly we eat? What does the food which has E300, E407, E410, or E942 written on it contain?

Molecule Models

While studying organic chemistry we encounter many interesting molecules that would be good to take a closer look at. It would be interesting to take the molecules in the hand and examine them from every angle. We can find a lot of 3D, revolving models on the internet, and with these the whole class - or even you, at home - can examine the molecules. You will need a special player, which you can download from the internet, to view some of these models.

Game

On the following link you can find 20 games. They cover several topics (ionic compounds, complex ions, periodic table, pH) in a variety of forms (memory, hangman, test, matching game). The games are in English, but many of them require only a basic knowledge of the language.

<http://www.quia.com/shared/chem/>

Note: on this site there are more games related to other subjects as well (Physics, Geography, Astronomy, English, etc.)

Information Technology

Introduction video for Parents' Day

Introduce your class with a short movie, using Windows Movie Maker 2. The students in the class should write some information about themselves, and rehearse it. Record everyone's introduction (about 5-10 seconds) and create a movie using various transitions and effects. Parents may view the product on the computer screen or using a projector.

Recommended software:

For creating movies from photos and videos: *Movie Maker 2*

(The Windows Movie Maker 2.1 is part of Windows XP Service Pack 2)